MACHINE DESIGN

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(Left) Typical mounting of grinder spindle on 2 New Departure Flanged Precision Ball Bearings. Note simplicity of installation with bearings located by accurately faced flanges.

NOTHING ROLLS LIKE A BALL

Simplified Mounting — Shoulders on the bearings instead of in the housing enable you to bore two bearing seats *straight through* at one set-up. Result: A saving in expense and perfect alignment of the bearings assured.

For Precision Workmanship — These precision spindle bearings are so designed that when applied under a moderate preload, extreme resistance to deflection under grinding loads is obtained.

With this combination of accurately aligned housings and ultra-precision bearings you get a cool, easy-running, yet very rigid mounting that needs no further adjustment and will assure maximum freedom from vibration or chatter.

The New Departure Mfg. Co. Bristol, Conn.

NEW DEPARTURE

ITEMIZED INDEX

Classified for Convenience when Studying Specific Design Problems

Key: Edit., Editorial Pages; Adv., Advertising Pages; R, Right hand column; L. Left hand column

CALENDAR OF MEETINGS AND EXPOSITIONS

CASTINGS continue to occupy a prominent place in the specifications of every designer . . . . Metallurgical research continues to bring out materials which have wider application * * * Latest developments in castings and in foundry practice will be presented at Thirty-ninth Annual Foundrymen's meeting at Royal York hotel, Aug. 19-23 * * * Chief among the materials to be discussed is iron castings . . . . Alloy cast iron, its impact resistance and other physical properties is the subject of G. P. Phillips . . . . A. DiGiulio and A. E. White will present the structure and properties of gray cast iron . . . . W. H. Spencer will head a round table luncheon conference on cast iron . . . . Wear resistance of white cast iron is the topic of O. W. Ellis, Jr., R. Gordon and G. S. Farnham . . . . Centrifugal castings, latest developments, will be covered by J. E. Hurst * * * Other speakers and conferences will cover steel, malleable and nonferrous castings . . . . A. J. Murphy will discuss high strength nonferrous castings.

Materials will again be the center of engineering attention in September . . . . The National Metal exposition opens in Chicago on the thirtieth * * * This seventeenth annual meeting and exposition will be held in conjunction with a number of other meetings . . . . American Welding society plans its annual fall meeting . . . . American Society of Metals will be at the Palmer House . . . . Iron and Steel and Institute of Metals divisions of American Institute of Mining and Metallurgical Engineers are to meet . . . . Wire association and divisions of American Society of Mechanical Engineers plan to hold meetings and co-operate with the metal congress.

Aug. 19-23—

American Foundrymen's association. Thirty-ninth annual meeting at Royal York hotel, Toronto, Ontario, Canada. C. E. Hoyt, 222 West Adams street, Chicago, is secretary of the association.

Aug. 19-23—

American Chemical society. Semiannual meeting to be held at San Francisco. Charles L. Parsons, 728 Mills building, Washington, is secretary of the society.

August 26-30—

National Association of Power Engineers. Exhibition to be held with the annual convention at William Penn hotel, Pittsburgh. Fred W. Raven, 1140 Lake Street, Oak Park, Ill., is secretary of the association.

Sept. 11-21—

National Machine Tool Exposition. Third exhibition of machines, parts and materials to be held in Public Auditorium, Cleveland, under the auspices of National Machine Tool Builders' association. Roberts Everett Associates, 232 Madison Avenue, New York, are managers of the exposition.

Sept. 11-21—

National Machine Tool Congress. Third congress to be held in Cleveland under the auspices of the Machine Tool Builders' association; Machine Shop Practice division, American Society of Mechanical Engineers; and Production Activity division, Society of Automotive Engineers. Herman H. Lind, 1220 Guarantee-Title building, Cleveland, is general manager of the Machine Tool Builders' association.

Sept. 16 —

Exhibit of Metals and Plastics. Permanent exhibition of ferrous and nonferrous metals, plastics, finished and semi-finished parts made from these materials and finishes for metals and plastics will open at International building, Rockefeller Center, New York. Herbert R. Simonds, Metal Products Exhibits Inc., Rockefeller Center, N. Y., is general manager of the exhibit.

Sept. 18-28—

National Electrical and Radio exposition. To be held at Grand Central Palace, New York. Information on the exposition may be obtained from Ralph Neumuller, managing director, Grand Central Palace, New York.

Sept. 24-26—

Association of Iron and Steel Electrical Engineers. Annual convention and exposition to be held at William Penn hotel, Pittsburgh. T. B. Little, Empire building, Pittsburgh, is acting managing director of the association.

Sept. 30-Oct. 4—

National Metal exposition. Seventeenth annual exhibition to be held in International Amphitheater, Chicago. W. H. Eisenman, 7016 Euclid avenue, Cleveland, is general manager of the exposition.

Sept. 30-Oct. 4—

American Welding society. Annual fall meeting to be held at Chicago. M. M. Kelly, 33 Thirty-ninth street, New York, is secretary of the society.

MACHINE DESIGN

THE JOHNSON PUBLISHING CO., CLEVELAND, OHIO

August, 1935 Vol. 7—No. 8

Rapid Gyrations Call for Balanced Control

By Lewis E. Soldan

Chief Engineer, Productive Equipment Corp.

VIBRATION, out of control, has wrecked many a machine; but vibration carefully and accurately controlled will perform useful work that cannot be done efficiently in any other manner. For example, vibrating screens, used for rapid, efficient separation of materials, find application in many and varied industries. A survey of the list of products which lend themselves to sorting by this type of machinery shows a range from peanuts to explosives, from meat scrap to iron ore, and includes rock products, chemicals, coal and numerous compounds.

Owing to the fact that no two materials are exactly alike—and that each has screening characteristics all its own, affecting good grading and demanding a distinct combination of throw or eccentricity, tilt or inclination of screen surface, speed, and screen cloth opening—a vibrating screen must essentially be adaptable to the material for best results, therefore be adjustable as to throw, tilt, speed, etc.

One of the most interesting problems in the design of the screen shown in *Fig.* 2, built by Productive Equipment Corp., Chicago, was the determination of means for securing this adjustability in throw. A compound eccentric, the parts of which may be adjusted in relation to each other to govern amount of throw, is employed in the vibrator assembly.

This assembly, which imparts vibrations to the screen frame proper, shown in *Fig.* 4, is located near the center of gravity of the machine and is fastened to the floating frame by SAE cap screws by means of which steel flanged sleeves *A* are attached to the side plates of the frame. A seamless steel tube, *B*, extends the width of the screen frame and telescopes into the flanged sleeves on each side of the frame.

A drive shaft, *C*, runs through the tube, its tapered ends fastened to balance wheels *D* by means of the end plate or stub shaft *E*. The end plate on the other end of the shaft varies only in that no provision for driving is made, therefore there is also no necessity for sealing the opening as a solid plate covers the end of the shaft. The balance wheel *D* is bored eccentric on the flanged side, and it is on this side that the complementary balance wheels or ring, *F*, is fastened. This complementary ring is machined eccentric on both its inner and outer surfaces and receives, at its internal eccentric surface, the bearing *H* which, in turn, is mounted on the flanged sleeves. This bearing, as well as the other bearings in the machine, is of the self-aligning, spherical roller type, selected to insure correct alignment of the component parts of the vibrator

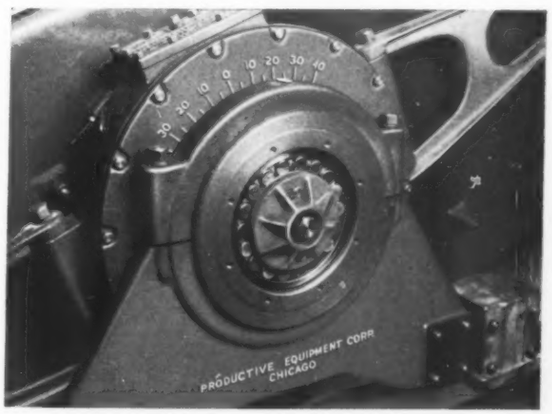


Fig. 1—*Self-aligning spherical roller type bearings carry shaft in vibrating screen*

assembly. With this, it can be seen that rotation of the shaft will cause the screen frame, with the tube, to gyrate about the shaft to the extent of the combined eccentricity of the balance wheels *D* and *F*. It is by use of a compound eccentric that a variance in amount of throw is possible. By adjustment of the two wheels, the eccentricity of one can be arranged around the shaft so that it neutralizes the eccentricity of the other, or the eccentricity of both may be built up to create the greatest possible throw. It is thus that the extent of gyration (or throw) depends on the particular setting or position of the eccentrics, which may be any one of eight different adjustments giving a throw of from 0 to $\frac{3}{8}$-inch.

It is necessary that vibration be created, but it is also necessary that this vibration be controlled. As a step in the proper control, each part of the compound eccentric carries its own counterweight to balance the thrown weights. This counterweight is applied in the same plane as the eccentric force, thus eliminating a possible wobbling of the eccentrics. This design also prevents possible bending moments on the shaft.

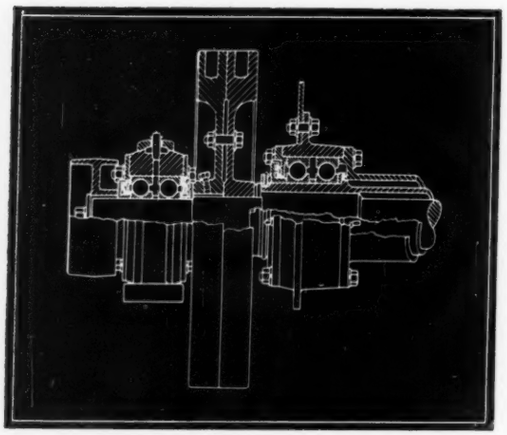
Another requirement of these compound eccentrics is that they may be adjusted easily by the operator. In this design, the eccentricity or throw is changed by merely removing cover plate *I* on the top side of the casing, reaching into the casing and unbolting the balance wheel complementary eccentric ring *F* from the balance wheel *D*, turning the rings relative to the balance wheel until the proper setting is obtained, then reinserting the bolts and cover plate. Suitable markings are provided on both members to simplify the operation. Balance plates are not changed or adjusted as they compensate automatically.

Design Reduces Number of Openings

This design of vibrator assembly has a number of advantages over previous designs such as the one shown in *Fig.* 3. The use of a full floating shaft eliminates the need for bearings in the tube. Also, the shaft may be machined straight through, as the stepped shaft in the earlier design is now unnecessary, consequently there is a saving in production costs. This straight through design and the placing of all of the vibrator parts in a casing does away with a number of openings which had to be sealed in the old design, thus making the vibrator more efficient.

Fig. 2—While vibration must be created for separation of materials, it is necessary that this vibration be controlled

Fig. 3—Stepped shafts, bearings in the tube and difficult seals are avoided by redesign



This assembly also permits of quick ,easy change from right to left-hand drive, as the full floating shaft is tapered on each end and both ends are identical. Therefore, it is only necessary to exchange the end plates and the covers. The stub drive shaft, usually equipped for V-belt drive in order to secure low wind resistance, quietness and moisture resistance, is inter-

changeable with other shafts of different dimensions suitable for other types of drive or direct drive.

The inclusion of all operating parts in the casing materially advances compactness and safety, while sealing, as noted in the foregoing, is considerably simplified. However, sealing is still an important problem, in the driving end of the shaft shown in *Fig.* 4 to prevent lubricant from contaminating the materials being processed. In the other end of the shaft, the entire vibrator assembly is enclosed in the casing with gaskets as the only precaution necessary to insure adquate sealing in addition to the flexible seal to be described in the following.

Oil lubrication was selected for the screen as this type of lubricant saves horsepower required for driving over grease. The design made the selection of oil possible, but the use of oil introduced additional sealing problems. The most important point for seals is the opening between the vibrator assembly and the gyrating screen. At this point it would be impossible to apply a stationary seal or a slinger type seal as the relative movement between the parts would destroy the efficiency of such a seal. However, a ring of synthetic rubber, *K*, fastened to both sides of the opening gives a flexible seal which withstands the twisting motion to which it is subjected as well as resisting the action of the oils used.

THE Third National Machine Tool Exposition to be held in September will enable the designer to see in one place the latest developments of one of the fastest moving divisions of the design industry. September issue of MACHINE DESIGN *will review these developments and discuss mechanisms, parts, materials, and processes. A summary of the highspots of the September number is given on page* 49.

For preventing lubricant from escaping along the stub shaft to the drive wheel, a slinger type of seal is employed. Lubricant seeping out along this shaft is caught by slinger *L* rotating with the shaft and is thrown on to the inside of its housing. Here it runs down the inside of the housing into the bottom portion, and flows through the opening at the bottom back into the vibrator casing. The lubricant will flow through this opening long before it rises to a point where it would flow on out the shaft opening. Also, a V-shaped opening in the slinger housing below the shaft acts as a wiper and tends to return much of the lubricant before it passes this point. An additional advantage of the slinger is its fan action which serves to repel the entrance of dust or foreign matter.

Correct tilt or inclination of the screen frame proper under varying conditions is another adjustment required of the screen. This tilt may be changed while the screen is in motion and is gaged by graduations on the housings as shown in *Fig.* 3.

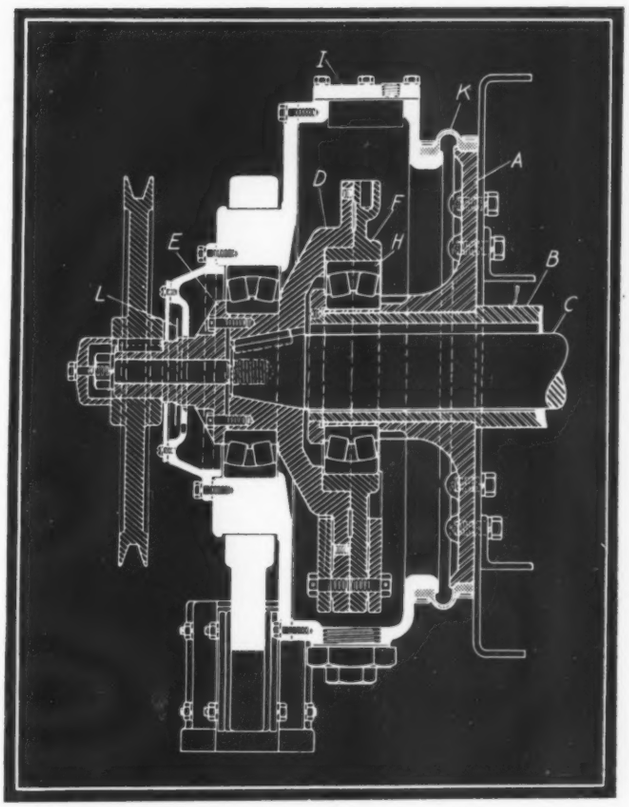


Fig. 4—Compound eccentrics regulate the amount of throw given to the screen on which materials are placed

Stabilizer Arms Locate Screen

The screen frame proper is maintained in its proper fixed position with respect to the base by four stabilizer arms which extend in opposite directions from the casings and are fastened to it by hinge pins to permit free lateral movement of the arms. Extreme ends of these terminate in circular live rubber disks, the hubs of which are secured to the side plates of the screen frame. These live rubber disks permit free gyrating movement of the screen frame, and, at the same time, keep the frame at the proper screening angle to which it has been set.

As can be noted in the foregoing discussion, while this design carefully creates vibration of the screens, every possible precaution has been taken to eliminate unwanted vibration and to reduce noise to a minimum. A further step along these lines is the mounting of the base on soft shoes, attached on the lower side, which permits the entire machine to float in live rubber. This base encircles the machine at the main, or concentric, bearing position as shown in *Fig.* 4. The upper portion of the base is split, thereby allowing for clamping action for holding the screen frame at the proper screening angle or tilt.

SCANNING THE FIELD FOR IDEAS

CENTRIFUGE WHIRLS INTO PROMINENCE

DELVING deeper into the study of applications of centrifugal force, engineers are discovering new and revolutionary ideas for employing it. Centrifuges now are being designed that strike a new high in man's attainments in overcoming gravity. One such centrifuge made public recently develops a centrifugal force 7,600,000 times greater than the force of gravity. An invention by Prof. Philip B. Bucky of Columbia university school of mines, combines the centrifuge and photoelastic apparatus to test engineering materials.

By the use of models and ratio tables he virtually peers into masses of concrete, stone and steel, making pictures of how the material is stressed under heavy load. A model of the structure undergoing tests is placed in the centrifuge and whirled. As the machine revolves, centrifugal force stresses the model as gravity would stress its prototype in a dam or mine. A camera records the "stress colors" on film, so that they may be studied and used for design.

DESIGNING FOR ACCESSIBILITY

ACCESSIBILITY is part and parcel of every good design. When the engineer overlooks it he immediately brings upon himself and his machine a shower of criticism from operators and maintenance men. "Make it Accessible" should be the slogan of every design department . . . . it will enhance the reputation of the company's machines in the field.

What can be accomplished in designing for accessibility is exceptionally well portrayed by the new Murphy diesel, *Fig.* 1. Here also is shown a special removing jig that can be funnished with each engine, which not only facilitates the removal of heavy pieces by one man but which holds them suspended safely, permitting inspection and work to be done on them.

Although these diesels are completely enclosed and are both oil and dust tight they are none the less easy to handle. Connecting rods and bearings, for instance, can be adjusted or replaced through hand holes, without removing pistons or rods. Fuel injectors can be removed and replaced rapidly. Only a single retaining device is turned to remove an injector; no fuel lines need be disturbed.

But perhaps the most important feature of accessibility on this diesel is the manner in which the camshaft housing holding the two overhead camshafts, and the cylinder head, can

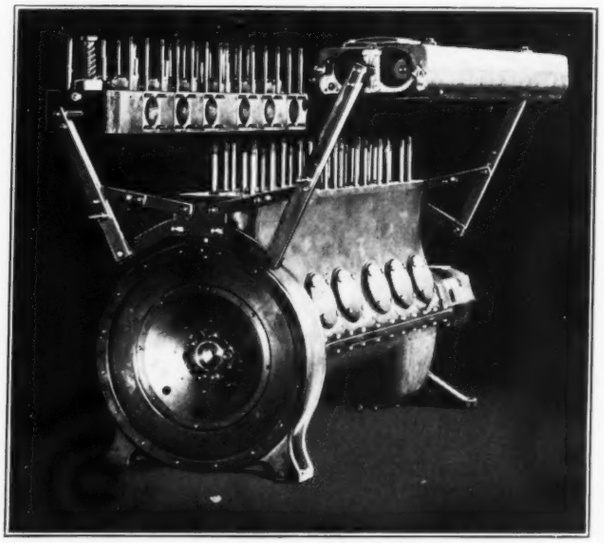


Fig. 1—*Heavy parts of this diesel are easily removable by one man and can be held suspended in a jig*

be removed and replaced by one man. Each of these pieces is handled as a unit, although the camshaft housing holds camshafts, injector operating controls, valve rocker arms, etc, while the cylinder head holds the valve assemblies.

PUTTING STATIC TO ROUT

WITH improvements in auto radio sets, increasing their sensitivity, came a new enemy—tire static. Friction of tire treads on the road surface, and flexing of the layers of the tires, builds up static electricity that results in a continuous unpleasant noise in the radio. To combat this condition, Chevrolet has adopted as regular equipment in all its master deluxe mod-

els, special tire static eliminators built in the rear wheels. These eliminators provide a metallic contact between wheels and chassis by which electricity collected in the tires is readily grounded.

VERSATILITY IN VEHICLES

WHAT promises to be the railroads' answer to bus and truck competition is the idea depicted in *Fig.* 2. The unit is called the Evans Auto-Railer, a combination vehicle that embodies retractible flange pilot wheels which make it adaptable for use on rails as well as on highway. Pilot wheels are held in position on the rails by compressed air and serve to keep the vehicle tires on the track without assuming any major portion of the load. Ease of riding thus is accomplished. Drive is effected through the rubber tires.

This versatility in design permits store door pick-up and delivery to the consignee without rehandling the load. Another advantage is the provision of economy in operating costs through the avoidance of highway grades and rough pavement as well as the elimination of frequent gear shifting and brake operation. The development is expected to be an aid in building new businesses through the extension of service to points not reached by rail, but which are readily accessible by highways connecting with nearby railroads.

Pilot wheel units are operated by levers in the cab and conversion from a rail car to a highway vehicle is instantaneous. The company now is equipping heavy tractor units for use in hauling and switching standard freight cars.

DON'T OVERLOOK APPEARANCE!

CHANGE for the sake of change is not good judgment, but redesign with a definite objective brings ample return. This is particularly true in regard to appearance. Moreover, no project is too large or too small to be considered from this standpoint. With these factors well in mind Minneapolis-Honeywell, in developing it's new thermostat, attained an attractive motif in the final design. The original model shown at the left in *Fig.* 3 lacked eye appeal. Henry Dreyfuss, industrial designer, was called in and the unit at the right of *Fig.* 3 shows his results.

In working out the problem every effort was put forth to make the thermostat appear small and to harmonize inconspicuously with any type of decorative scheme. A central panel and a stepped-out back panel aided in breaking the mass. Top and bottom ventilation proved more efficient from an engineering standpoint than previous side ventilation and worked in more effectively with the desired appearance. The setting wheel was placed at the top of the instrument instead of at the bottom as on the previous model. Numeral and thermometer markings were simplified to facilitate legibility. By employing a neutral lacquer a metallic finish has been procured that does not chip or scratch easily and is sufficiently neutral to harmonize with any color scheme.

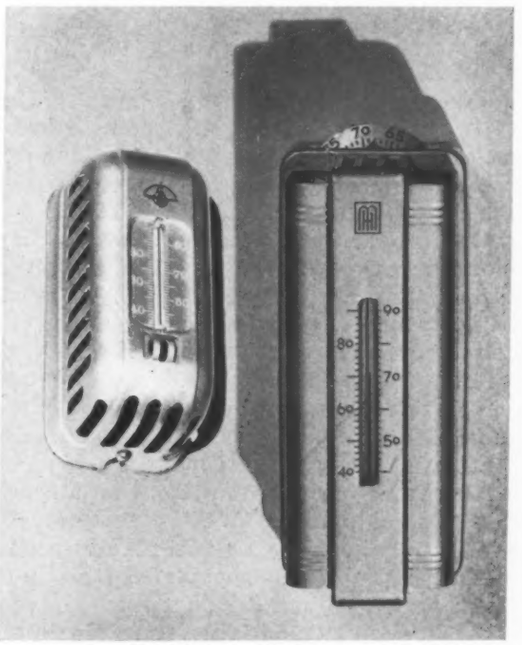


Fig. 3—Contrast between appearance of thermostat model (left) and accepted design (right) offers study in eye appeal. Photos of these units are not on same scale—actually the new unit (right) is smaller than original model

Fig. 2—Retractible flange pilot wheels adapt rubber-tired vehicle for operation on rails as well as highway

ALIGNER PROLONGS BEARING LIFE

SMALLER bearings for steel mill roll neck service, with a corresponding decrease in the size and cost of surrounding parts, now can be

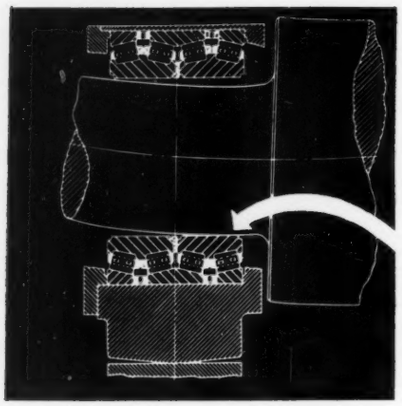
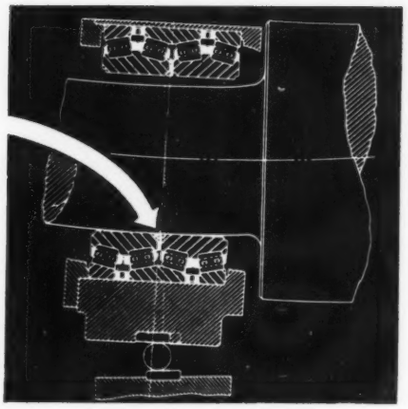


Fig. 4—A roller aligner permits the load to be distributed over entire length of bearing as shown in the view at right. Some conception of how an ordinary bearing mounting is thrown out of alignment when roll is deflected can be gained from the drawing at left



used effectively by employing a roller aligner, *Fig.* 4, right. Poor distribution of load over the length of the bearing when roll necks deflect has been a limiting factor in roll neck bearing life.

This condition is depicted at the left in *Fig.* 4, an ordinary bearing mounting in which there is no method provided whereby the bearing can align itself to accommodate the deflection of the roll. Therefore, the load is carried on the corner of the rollers nearest the roll body. *Fig.* 4, right, shows how the new Bantam roller aligner allows the chock to rock and relieves the load in the corners of the rollers by carrying the load over the entire length of the bearing.

Three major parts comprise the aligner; a hardened steel plate which is fastened in a groove in the chock by a small clamp; a similar plate that rests on the bottom of the housing window; and a roller divided into convenient lengths between these plates and held in a cast bronze cage. Cage and roller assembly is located by springs which hold it central while rolls are being changed.

RELIEVING MAN'S RESPONSIBILITY

NUMEROUS applications will be found for a new twenty-four hour electric time control that recently made its appearance on the market. Known as the "Tymit," this device, *Fig.* 5, serves such useful purposes as switching the radio on and off at predetermined intervals, defrosting the refrigerator or operating other electrical appliances. It undoubtedly will find wide use industrially also. Tork Clock Co. Inc. is the manufacturer of the instrument which is housed in an attractive case of lustrous Bakelite molded material in either jet black or walnut.

WATCH HYDROGEN PURIFIED IRON!

A STUDY of hydrogen-purified iron at Bell Telephone Laboratories offers some interesting information. The iron ring, *Fig.* 6. magnified in the illustration, shows the large crystal grains characteristically produced by high temperature treatment in hydrogen. Iron so treated has properties that are very different from those of ordinary annealed iron; particularly a high magnetic permeability and low hysteresis loss. It has been suggested that the coarsened crystal structure might account for this change in properties, but evidence accumulated at the Laboratories tends to show that the change is rather the result of the removal of microscopic impurities.

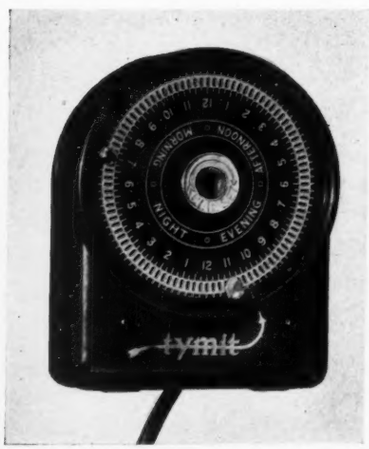


Fig. 5 — Left—This device, providing twenty-four electric time control is housed in a case of molded plastic material

Fig. 6 — Right — High temperature treatment of iron ring in hydrogen produces high magnetic permeability and low hysteresis loss

Fig. 1—Grinder housing is amply rugged to withstand rough usage to permit high speeds

Have Plastics Outdistanced the Designer?

By F. E. Brill
General Plastics Corp.

TO THE uninitiated machine designer the phrase molded plastics probably brings to mind knobs, handles and a few other small and undramatic parts. Actually, synthetic molding materials have long since passed the knob-and-handle stage and are now a full-fledged structural material—due mainly to increases in the strengths of certain phenolic compounds of 300 to 400 per cent, increases in molding speeds of about 100 per cent and reductions in cost of about 40 per cent. All this has occurred in the last few depression years.

What this means to engineers is that molded plastics can now be considered in practically the same light as die castings and smaller stampings, since the average phenolic molding now costs about the same as a plated or enameled die casting. The structural strengths of molded parts are not yet equal to steel, zinc or aluminum, but for medium and light-duty machine housings, frames, hoods, appliance cases, covers, etc. and for a variety of mechanical parts, they are adequately strong. We are referring now mainly to the phenolic plastics, (Durez, Bakelite, etc.) which are the most suitable for precision work where dimensional stability and constant dielectric and impact strengths are vital. They, incidentally, are the lowest in cost, the most inert and strongest, and can be held to close tol-

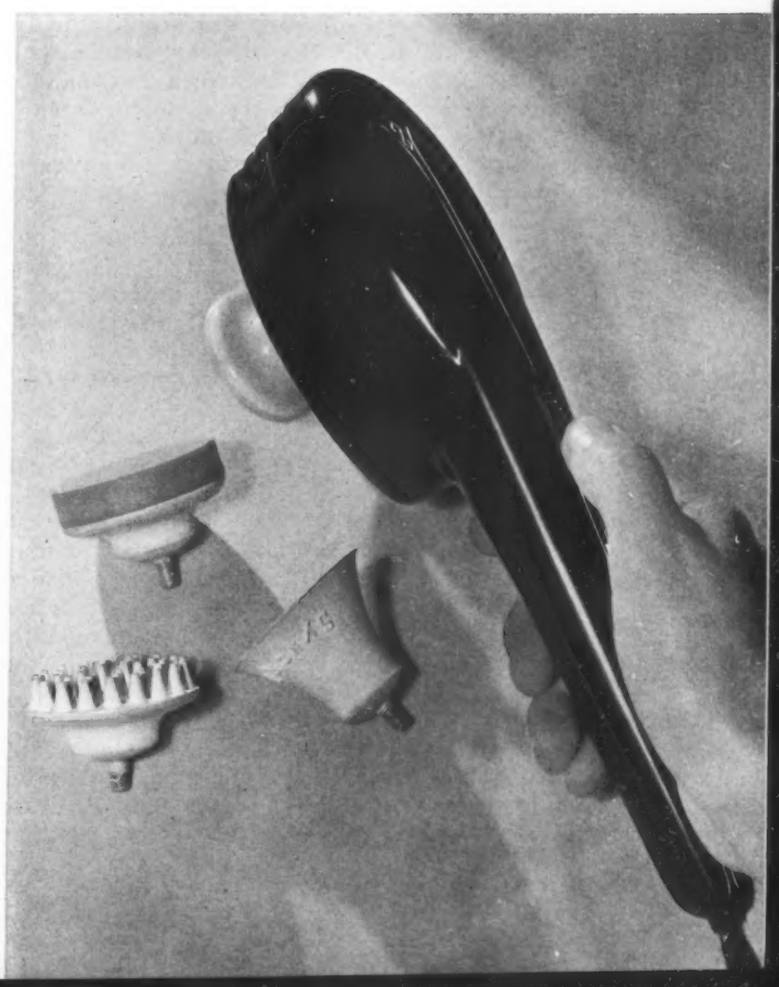


Fig. 2—Two molded pieces form a light weight but sturdy frame and bearing retainer for motor mounting and housing

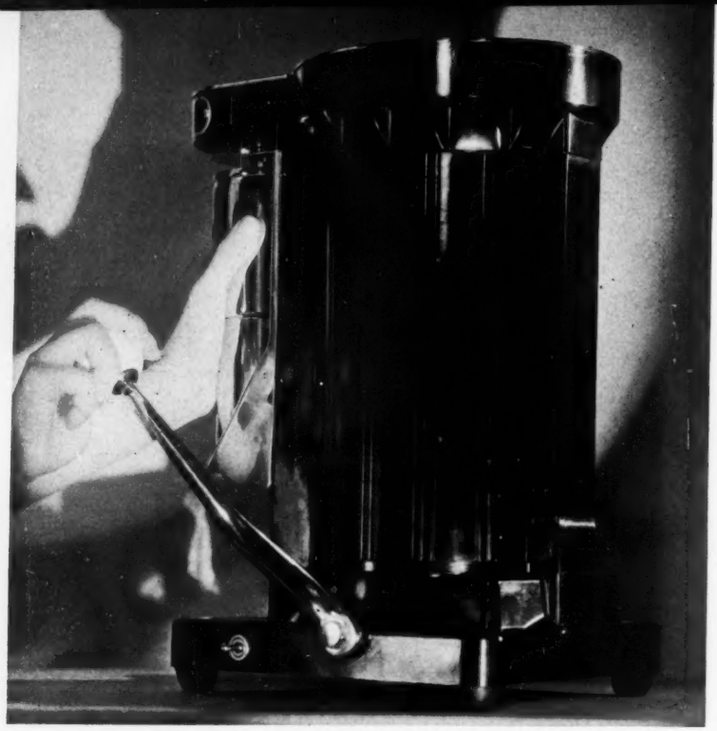


Fig. 3—Motor in whipper and mixer revolves on shafts mounted in oilless bearings molded into the base and upper frame

erances. The urea plastics, (Plaskon, Beetle, etc.) are used for pastel-colored housings, etc.

Obviously, there are applications in machine design where the elimination of finishing costs, the permanent lustre, the resistance to corrosion and rust and the extreme light weight of molded phenolic parts are very desirable, and it is to the advantage of the designer to fix in his mind just where these materials fit into the picture. Can a molded housing, for instance, be used on a high-speed drill or grinder? Can a vacuum cleaner be molded? Can a sewing machine frame be made of plastics? How about a meat grinder, a fan base or standard, a floor sander, an adding machine, a movie-projector case, a check-writer housing, electric clocks, timing devices, etc? We can best find the answers by studying past applications, and using common sense in planning future ones.

Withstands Rough Usage

Let's look over some of the accompanying illustrations. Note the tiny grinder with the striped body, *Fig.* 1. Due to molded phenolic end-housings, with grip and bearing retainers, it weighs but 15 ounces, yet is amply rugged to stand rough usage and attain speeds of 25,000 R.M.P. A somewhat similar use of phenolic molded housings for electrically-operated tools and appliances is indicated by the vibrator-massager shown in *Fig.* 2. Two molded pieces form a light weight but sturdy frame, bearing retainer for motor mounting and housing which resists considerable handle-pressure and vibration and yet is sleek and attractive. Designed by Henry J. King, automotive designer, the housing's shape brings out the real beauty of plastics.

Also along these lines is a new heavy-duty portable grinder recently announced by Skilsaw, on which a molded phenolic housing replaces the customary metal case and frame, lightening the weight, keeping the grip surface cooler, eliminating insulation and preventing any tendency to chip and rust. It is made of extra-strength material to resist banging on garage floors.

In analyzing these applications one finds that the molded housings do a double job of forming both the exterior case and also acting as bearing points and internal frame. This is made possible by the molding in of metal inserts or bearings to

Fig. 4—Case molded from plastics merely drops over a die cast base to which the mechanism is fastened in adding machine design

support both reciprocating and stationary parts. The large Andis restaurant whipper and mixer, *Fig.* 3, is another example of this construction. A 1/6-horsepower motor drives the various shafts which revolve in oilless bearings molded into the base and upper frame during the molding operation. This 16-inch giant among whippers, incidentally, is molded in three pieces of phenolic materal, which was chosen partly for light weight and partly because its chip-proof surface was obviously more sanitary.

Another example is the Hanau Electroformer, *Fig.* 6, which has a one-piece molded case automatically mold-finished and permanently acid proof. Into this case go ammeters, transformers and other parts, all rigidly mounted to tapped fillets and inserts.

There is another method of using plastics for machine housings, in which it is combined with a metal base which bears the load. An example

of this is the Barrett adding machine case, *Fig.* 4, in which the molded case merely drops over a die-cast base to which the mechanism is fastened. This type of housing assembly is generally used on larger machines which require unsupported planes and edges of the molding a foot or more in length. The recently redesigned Hobart meat grinder, *Fig.* 5, uses this type of molded plastic housing. Surprising rigidity and impact resistance in the housing is obtained.

Besides these combination frame-and-housing applications and the merely slipped-on covers, there are many places where phenolic plastics can be used as integral parts of machines. One instance of this is in the motor housings of the Comptometer motor, which are molded of phenolic material of both standard and extra strength type, and which embody assembly lugs, vent holes, molded-in bearings, inserts, terminals, etc., all in one prefinished piece. Here the self-insulating qualities of the material, its simplification and its light weight, dictated its use. Such a use for plastics would have been laughed at a few years ago.

Fig. 5—Surprising rigidity and impact resistance in the housing is obtained with molded part combined with metal base

So much for past applications. What about the future? Just how far can a designer go in planning new uses for plastics?

Already, we believe, the plastics industry is ahead of the designer. Materials now available have not yet been generally used. There are extra-strength phenolic materials that are more than strong enough for vacuum cleaner bodies, for sewing machines, dictating machine housings and the like. Strength tests today amaze the average designer. Some of these materials, when properly molded in correctly designed dies into lightweight housings, can be kicked down a flight of concrete stairs, dropped from the ceiling to a concrete floor without so much as a nick. Moldings two feet long by a foot deep are practical and often economical. Molded plastics have been adopted by the country's leading camera designers as the ideal material for camera cases. The average engineer, however, is still tradition-bound, and thinks too much of the old-time materials to get the full advantages of the versatility of these new plastics.

Many New Designs Projected

During the past year, designers of machinery have made great steps forward in putting phenolic plastics to new uses. In the coming year even more new uses will be found. Motorcar designers are particularly foresighted: dashboards, visors, window trim, are some of the parts to be made of plastic materials shortly. Vacuum cleaners are being lightened and smartened with molded mechanical parts and housings. Office machinery is going plastics. Electrical appliances and devices are using molded bases, molded covers, molded parts, to get lighter weight, smoother lines and indestructible finish. New labor-saving tools are being lightened and made more easily handled with molded housings and parts. Molded plastics are rapidly becoming one of the prime materials at the disposal of the machine designer, particularly in the lighter class.

Fig. 6—One-piece molded case is automatically mold-finished and permanently acid proof. Parts are mounted in inserts

Should Chain Drive Tables Be Revised?

ABSTRACTED from a paper presented at the semiannual meeting of Mechanical Engineers by G. M. Bartlett, consulting engineer, Diamond Chain & Mfg. Co., and professor of machine design, Purdue University. Mr. Bartlett points out the many factors influencing chain life, not covered completely by existing tables, and indicates the desirability for consultation with manufacturers in selecting chain drives for machinery.

IN DESIGNING a chain drive it is customary to refer to tables and charts to determine the allowable load carried by a given chain at a given speed, and, after making due allowances for special conditions as dictated by one's judgment, a selection of a suitable chain model is made.

By means of one chart frequently used, the chain is selected on the basis of the horsepower to be transmitted and the revolutions per minute of the smaller sprocket. By means of certain tables in common use, the chain is selected on the basis of chain velocity and either chain pull or horsepower. In another table, the revolutions per minute of the smaller sprocket and its number of teeth are the given data.

While such tables are easy to use and economical to print, it has long been realized that unless all other conditions are satisfactory the tabulated ratings are likely to be erroneous.

Number of teeth in the smaller sprocket affects the rapidity of wear of the chain, the uniformity of chain velocity, the efficiency of the drive, and the endurance limit of the chain.

Rapidity of chain elongation is affected by the chain pull, the horsepower, the sprocket speed, the length of the chain bushing, the chain length, the product of the number of teeth in the two sprockets, and the character of the lubrication; but it is independent of the pin diameter unless the unit pressure on the pin is excessive.

Rapidity of sprocket-tooth wear due to roller impact is affected by the pitch, the weight of the chain, the size of the rollers, the revolutions per minute, the character of the lubrication, and the tangential distance along the tight strand of the chain.

The principal consideration in the design of a chain drive is long service for both chain and sprockets. But such considerations as compactness, quiet action, light weight, or low initial cost may sometimes become paramount.

In most cases of chain drive calculations, the known quantity is RPM of the smaller sprocket rather than the chain velocity; and so a convenient and informative table for reference would be one in which the sprocket speeds are read at the top of the table and various combinations of teeth are listed in the left-hand columns, as shown in the accompanying table.

Tables of this sort would be extensive, but their usefulness offsets the disadvantage of cumbersomeness.

Horsepowers for Standard Roller-Chain No. 80[a]

			Cent.	Speed of the smaller sprocket, rpm												
N^1	N^2	LP	dist. (pitches)	162	183	202	225	252	281	313	348	386	433	487	547	940
15	15	56	20.50	8.42	8.42	8.41	8.41	8.41	8.40	8.39	8.38	8.37	8.32	8.32	8.28	7.72
15	18	58	20.74	8.42	9.52	9.51	9.51	9.51	9.50	9.39	9.38	9.37	9.32	9.32	9.28	8.72
15	21	60	20.97	8.42	9.52	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.4	10.4	10.4	9.81
15	25	62	20.93	8.42	9.52	10.5	11.7	11.7	11.7	11.7	11.7	11.7	11.6	11.6	11.6	11.0
15	30	66	21.61	8.42	9.52	10.5	11.7	13.1	13.1	13.1	13.1	13.1	13.0	13.0	13.0	12.4
15	36	68	20.97	8.42	9.52	10.5	11.7	13.1	14.6	14.6	14.6	14.6	14.5	14.5	14.5	13.9
15	43	72	21.01	8.42	9.52	10.5	11.7	13.1	14.6	16.2	16.2	16.2	16.2	16.2	16.1	15.6
15	51	78	21.73	8.42	9.52	10.5	11.7	13.1	14.6	16.2	18.1	18.1	18.0	18.0	18.0	17.4
15	60	84	22.06	8.42	9.52	10.5	11.7	13.1	14.6	16.2	18.1	20.8	20.8	20.8	20.7	20.2
15	72	90	21.28	8.42	9.52	10.5	11.7	13.1	14.6	16.2	18.1	20.8	22.4	22.4	22.3	21.8
15	86	102	22.91	8.42	9.52	10.5	11.7	13.1	14.6	16.2	18.1	20.8	22.4	25.2	25.2	24.6
15	102	116	24.82	8.42	9.52	10.5	11.7	13.1	14.6	16.2	18.1	20.8	22.4	25.2	28.3	30.1
19	19	60	20.50	10.8	11.6	11.6	11.6	11.6	11.6	11.6	11.5	11.5	11.4	11.4	11.3	10.2
19	21	62	20.99	10.8	12.1	12.4	12.4	12.4	12.4	12.4	12.4	12.3	12.3	12.2	12.1	11.0
19	25	64	20.97	10.8	12.1	13.3	13.9	13.9	13.9	13.9	13.9	13.8	13.8	13.7	13.7	12.5
19	30	68	21.67	10.8	12.1	13.3	14.8	15.7	15.7	15.7	15.7	15.7	15.6	15.6	15.5	14.4
19	36	70	21.07	10.8	12.1	13.3	14.8	16.6	17.7	17.7	17.7	17.7	17.6	17.6	17.5	16.4
19	43	74	21.15	10.8	12.1	13.3	14.8	16.6	18.5	19.9	19.9	19.8	19.8	19.7	19.7	18.5
19	51	80	21.89	10.8	12.1	13.3	14.8	16.6	18.5	20.6	22.2	22.1	22.1	22.0	22.0	20.8
19	60	86	22.27	10.8	12.1	13.3	14.8	16.6	18.5	20.6	22.9	24.9	24.8	24.8	24.7	23.6
19	72	92	21.57	10.8	12.1	13.3	14.8	16.6	18.5	20.6	22.9	25.3	27.8	27.8	27.7	26.6
19	86	104	23.26	10.8	12.1	13.3	14.8	16.6	18.5	20.6	22.9	25.3	28.4	31.4	31.3	30.2
19	102	120	26.38	10.8	12.1	13.3	14.8	16.6	18.5	20.6	22.9	25.3	28.4	31.4	35.7	37.6

[a]Pitch = 1 in. Bushing length = 0.875. Bushing diam. = 0.312. Wt. per foot = 1.63 lb. Max. speed = 940 RPM. Lp = Length in pitches.

Avoid Waste of Material in Parts Design!

By V. L. Maleev

Professor of Mechanical Engineering,
Oklahoma Agricultural and Mechanical College

Third of a Four-Part Series

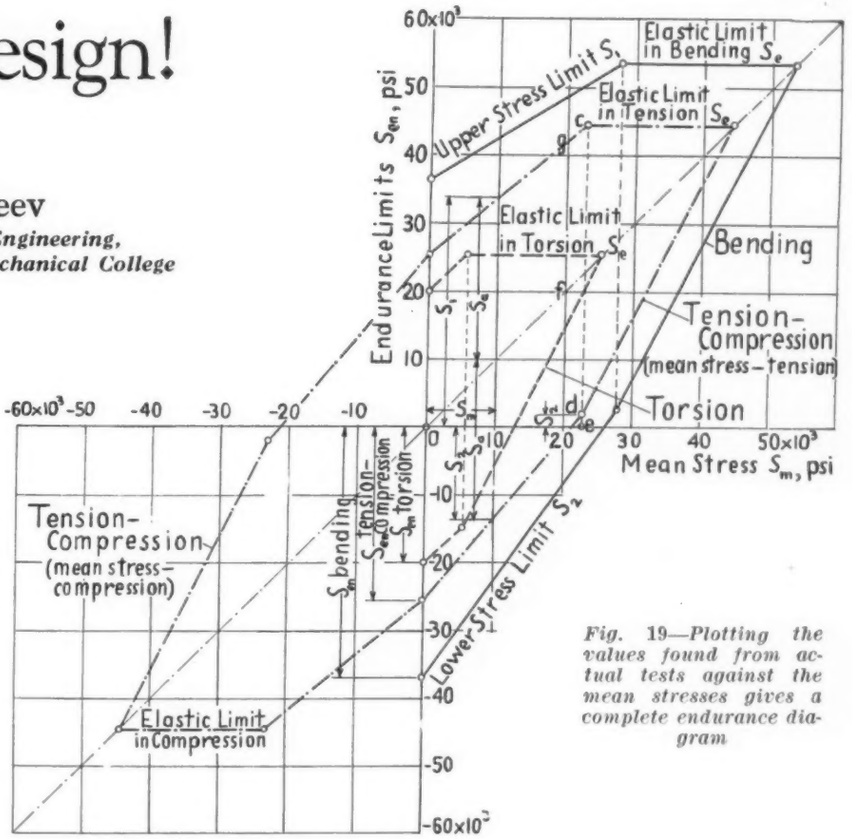


Fig. 19—Plotting the values found from actual tests against the mean stresses gives a complete endurance diagram

EXPERIMENTS have shown that metals will fail when loads are repeated or reversed several millions of times, even if the unit stresses do not reach the elastic limit. This phenomenon until recently was called fatigue of metals. Repeated loads together with steady loads and impact or shock loads, discussed in the July issue of MACHINE DESIGN, form the three main types of loads which must be distinguished in this design method, first introduced in June.

At present it has been established that the failure from *repeated loads* is due to a crack which occurs at a point on the surface of the member where the highest stress exists. This fissure gradually spreads until failure takes place. *Fig.* 18 illustrates this phenomenon by means of lines of flow of forces; the dotted line *b*, sketch (*a*), connects the points of maximum stresses; sketch (*b*) shows the beginning of a crack; sketch (*c*) and (*d*) show the gradual increase of the crack depth. The fracture follows the surface of maximum stresses and is always normal to the nearest line of force flow, as shown. A characteristic of the failure by progressive fracture is a complete absence of elongation and reduction of the area at the break. In general, ductile metals do not resist repeated stresses better than brittle metals[15].

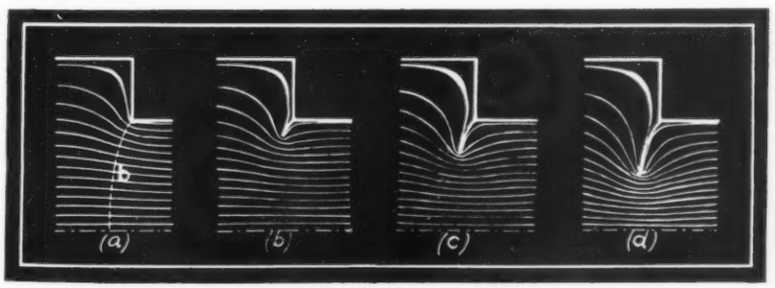


Fig. 18—Fissure at the point where highest stress exists gradually spreads until failure of the part takes place

The stress which can be repeated an infinite number of times without causing failure by progressive fracture is called the *endurance limit* of a material. There does not exist any definite relation between the

[15]Gillett. H. W., *Proc. A.S.T.M.*, 1930, part I, p. 291.

elastic and endurance limits; but there seems to exist a fairly definite relation between endurance limits and ultimate strengths. Furthermore, the endurance limit depends not upon the maximum stress but upon the range of stress variation. Thus, if the total stress changes from a maximum value in one direction, as tension, to the same value in the opposite direction, compression, the endurance limit for steels in bending is equal to about one-third of the ultimate strength

$$S_{en\pm} = (1/3)S_u \quad \text{.....(22)}$$

For most nonferrous metals S_{en} is about ¼ S_u. If the stress changes from zero to a maximum,

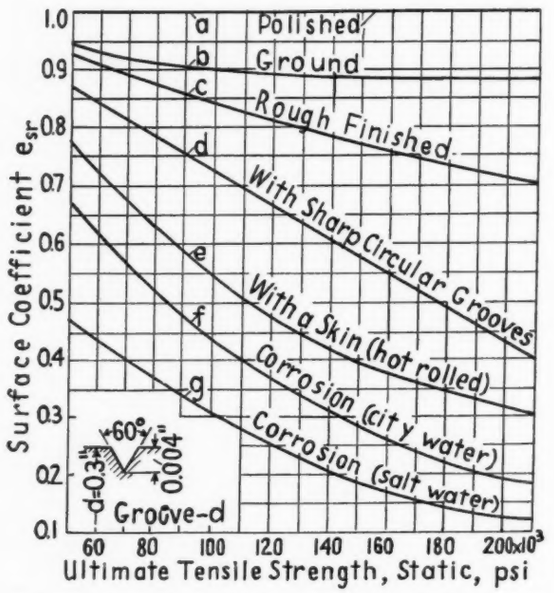


Fig. 20—Values of surface coefficients can be used for bending, tension and compression

the endurance limit increases to about one-half of the ultimate strength

$$S_{en+,0} = (1/2)S_u \quad \text{.....(23)}$$

If the lower stress has the same sign as the upper stress and is sufficiently high, the endurance limit may reach the elastic limit. These conditions can be best illustrated by a diagram which is a more elaborate form of the well known Goodman's diagram. Designating by S_m the mean value of the upper stress S_1 and lower stress S_2, where the stresses are taken with their signs, (+) for tension and (—) for compression,

$$S_m = (S_1 + S_2)/2 \quad \text{.....(24)}$$

and plotting the values of S_1 and S_2 found from actual tests against the mean stresses S_m, diagram *Fig.* 19 is obtained[16]. When the upper stress reaches the elastic limit at point *c*, point *d* on the same vertical line determines the corresponding value of the minimum stress, $S_2 = e\text{-}d$. Stresses above the elastic limit do not present any interest for machine design. If the upper stress decreases and the lower increases, so that $S_1 < S_2$, the left part of the diagram *Fig.* 19 is obtained. For ductile materials the left half is identical with the right one with the deciding influence changed from tension to compression and therefore is usually omitted.

The difference of the stresses S_1 and S_2 divided by two is called the stress amplitude

$$S_a = (S_1 - S_2)/2 \quad \text{.....(25)}$$

A line drawn through the center of the co-ordinates at 45 degrees permits to find directly the value of a stress amplitude S_a which corresponds to a given mean stress S_m. Thus, for S_m = 20,000 pounds per square inch, a stress amplitude $S_a = f\text{-}g$ is found which according to the scale corrresponds to 22,000 pounds per square inch; for S_m = 10,000 pounds per square inch, S_a = 23,600 pounds per square inch.

Progressive fracture can be the result of the repetition of either direct loads, or bending moments, or torques. The general relation of the endurance limits for different stresses is similar to that shown in *Fig.* 19 and depends upon the range of stresses. The endurance limits in tension or compression are lower than in bending; for steels they average about 70 per cent of the latter, and those in torsion are still lower, averaging about 59 per cent of the bending limit; for cast iron the endurance limit in torsion is about 92 per cent of that in bending[17]. The endurance limits as given for various materials usually are found by subjecting the test specimens to repeated bending in opposite directions. At present all more important materials are sufficiently investigated to draw endurance diagrams and the latter are available for practical use[18].

Constructing Interpolated Diagrams

For a material for which the endurance diagram is not yet established, a preliminary diagram can be laid out using the endurance limit S_{en} as found for alternating bending, and taking for the elastic limit in bending $S_{eb} = 1.1S_e$, where S_e is the elastic limit in tension. The incline of the upper stress line and other lines are drawn comparably to established diagrams, preferably to those having approximately the same ratio of S_{en}/S_e. The endurance limits in tension and torsion must be correspondingly lower than in bending, as stated in the foregoing.

Endurance limit of a certain material, as already mentioned, is not a definite characteristic but depends upon the following conditions:

[16] *Supplement to Z V. d. Ing.*, No. 42, Oct. 21, 1933.

[17] Herold, W., *Wechselfzstigkeit Metallischer Werkstoffe*, Wien, 1934, p. 69.

[18] These diagrams are given for 13 different carbon and alloy steels in the supplements to *Z. V. d. I.* No. 42, Oct. 21, 1933; No. 50, Dec. 16, 1933; No. 4, Feb. 17, 1934; No. 12, March 24, 1934. Blueprints of these diagrams, changed to the English units, can be obtained from the writer.

(a) amplitude of stress variation; (b) mean value of the stresses; (c) type of stresses invoked; (d) method of manufacturing the material, including its heat treatment; (e) size of the section; (f) condition of the surface; and (g) discontinuities in the sections.

Development of Endurance Stresses

The influence of the first three conditions, (a), (b), (c), is best expressed by a diagram such as *Fig.* 19. The calculations are based on stress amplitudes, on the corresponding endurance amplitude S_a, *Fig.* 19, and the nominal stress amplitude s_{na} computed from the conditions of loading by the elementary strength equations.

Methods of manufacturing and of heat treatment influence the endurance limits but this influence can be established only experimentally and is taken into account in a corresponding endurance diagram.

Size influence can be expressed by the same size coefficient e_{sz}, expression (5), (M.D., June, p.17), as for the elastic limit [19]. For shafts over 3 inches diameter e_{sz} may be taken equal to 0.75, until more experimental data are available. The size correction is referred to the value of the stress amplitude S_a, and not to the whole endurance stress S'_{en}. The corrected stress amplitude

$$S'_a = e_{sz} S_a \quad \text{.....(26)}$$

Nature of Surface Important

Experiments show that the nature of the surface has a very great influence upon the endurance of metals. The surface influence increases with the increase of the static ultimate strength of materials. The highest values of endurance strength are obtained with a perfectly smooth polished surface. Slight scratches, as obtained in grinding, reduce the endurance by 5 to 12 per cent; a rough finish reduces it still more. A sharp circular V-groove, only 0.044 inch deep, may reduce the endurance strength of a shaft under certain circumstances up to 63 per cent. *Fig.* 20 gives curves showing these influences for materials with various ultimate strengths expressed as a *surface coefficient* e_{sr}. This influence must be referred to the stress amplitude S_a the same as the size coefficient. Thus, the corrected stress amplitude with expression (26), becomes

$$S''_a = e_{sr} \times e_{sz} \times S_a \quad \text{.....(27)}$$

The values of e_{sr} from *Fig.* 20 can be used for bending, tension, and compression. For torsion the surface influence is smaller and the corresponding value e'_{sr} can be computed by the expression [16]

$$e'_{sr} = 0.425 + 0.575\, e_{sr} \quad \text{.....(28)}$$

Superficial plastic distortions as cold-chisel marks, hammer-blow marks or center-punching do not effect the endurance appreciably, but all scratches, such as coming from vise jaws or from press fits, are almost as harmful as sharp grooves, curve *d*, *Fig.* 20.

Even greater than the effect of mechanical imperfections of the surface is the corrosion effect, *Fig.* 20, which must be by all means prevented.

Thus, the *design stress amplitude* can be presented as

$$S_{da} = e_{sz} \times e_{sr} \times S_a / f \quad \text{.....(29)}$$

where the safety factor f should be not less than 1.25 for aircraft design, and 1.5 or greater in all other cases.

Discontinuities affect the endurance strength of machine parts. However, the effect is considerably smaller than could be expected from the values of form factors k computed theoretically or determined by static methods. For repeated stresses this influence is expressed by the ratio

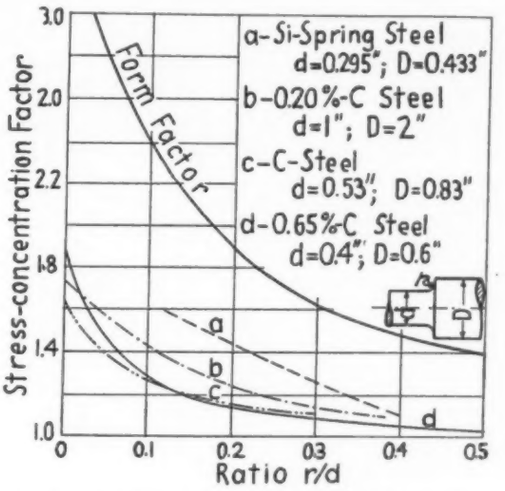


Fig. 22—Influence of relative size of discontinuities in shafts with fillets

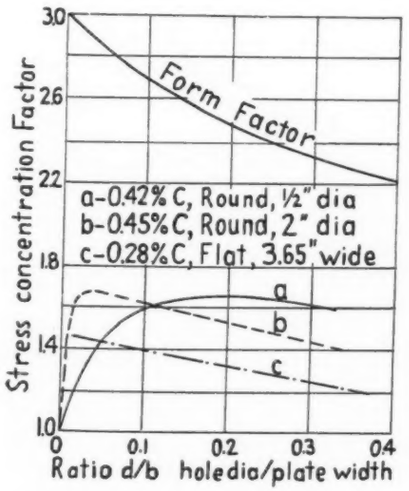


Fig. 21 — Stress concentration factor found experimentally for bending of bars with transverse holes

[18]Supplement to *Z. V. d. Ing.*, No. 34, Aug. 25, 1934, pp. 2, 4.

[16]Supplement to *Z. V. d. Ing.*, No. 42, Oct. 21, 1933.

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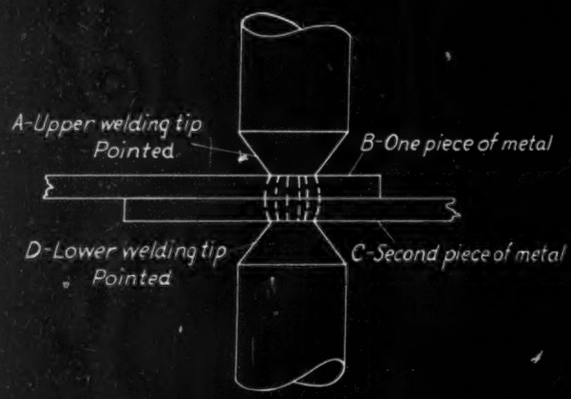


Factors to Consider for Projection

Fig. 1—In spot welding the work is squeezed by the tips and current passed across the work between tips

By A. M. Wallace

A SPOT weld may be fully described as the union of metals by localized heating and pressure. The process is a utilization of the fact that an electric current passing through a metallic conductor heats it, the temperature attained being proportional to the square of the current, the resistance of the conductor, the time during which current flows, the specific heat of the metal of the conductor and the rate of dissipation of this heat. *Fig.* 1 shows two pieces of metal between the welding tips of a spot welding machine. The work is squeezed by the tips (welding pressure) and a current of several thousand amperes flows across the work between the tips. The resistance offered to the passage of current from one piece to another, and the length of the current path through the pieces *B* and *C* cause the current to generate sufficient heat to raise the metal to welding temperature, when the pressure applied by the tips forces the surfaces of *B* and *C* to flow together and disappear. Forging pressure, applied at the end of the heating period, assures a perfect weld.

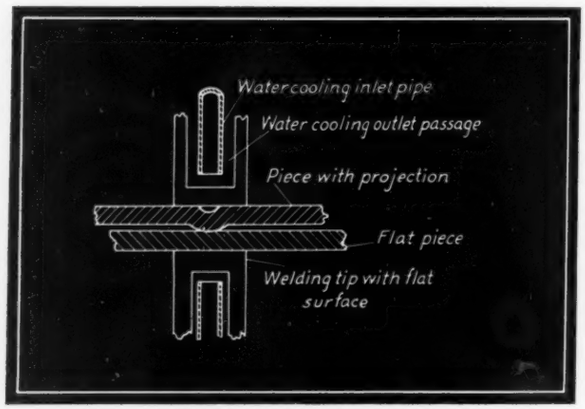


Fig. 2—Projection welding joins sheets when one sheet is formed as shown here

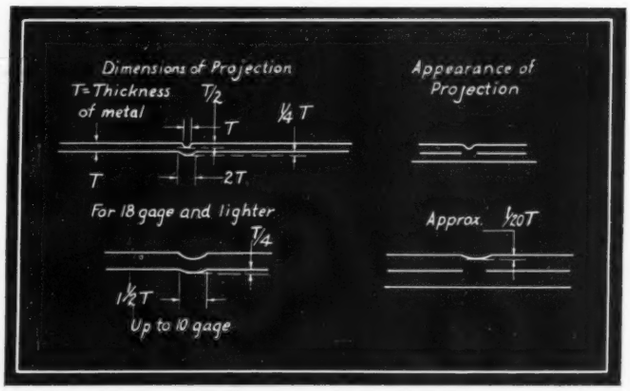


Fig. 3—Proportions of a projection decrease after welding, giving an improved appearance to the part

In the spot weld as shown, the area of the metal heated to this forging temperature is about the same as the area of the welding tip, due to the welding pressure which causes current to concentrate where it is greatest, and the total volume of metal heated is this area times the thickness of the work.

Projection welding in its simplest form is illustrated in *Fig.* 2. The welding tips provide large flat surfaces in contact with the work. Electric current concentrates where the projections touch the metal and heating is localized there. There are two advantages to the use of projection welding. No distortion of the work occurs, for the electrode surfaces conform to the surfaces of the work and act somewhat as a forming die, and heating and bending occur only in the projection itself. The second advantage is that several projections may be welded at the

when Designing Parts or Spot Welds

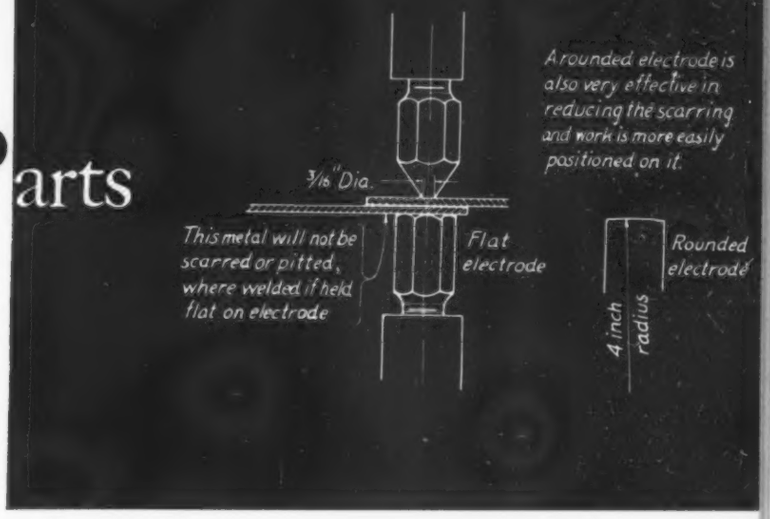


Fig. 5—Pitting on one side may be eliminated by the use of one flat tip

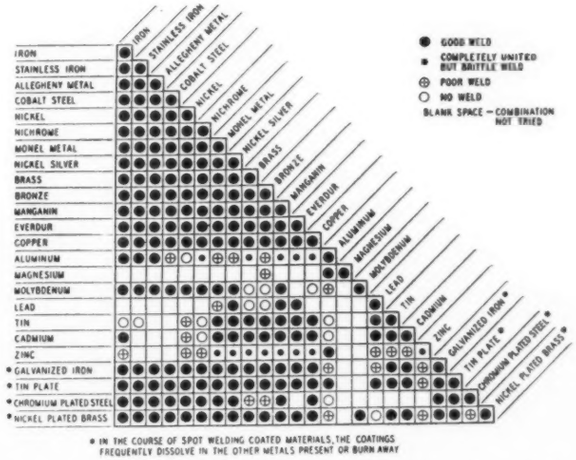


Fig. 4—Weldability of materials by spot welding is important in design

same time. A 600 KVA welding machine has been built where at one stroke twenty-one projection welds are made simultaneously.

Pieces to be assembled by spot welding require no preparation. If projection welding is to be used the projections must be specified on one of the pieces. The appearance of a spot weld made as shown in *Fig.* 1 is a slight pitting of both sides of the sheets welded, where the welding pressure causes the plastic metal to flow. By use of one flat tip, and one pointed tip as shown in *Fig.* 5 the pitting on one side may be eliminated. The appearance of the projection weld is very similar to the appearance of the weld made with one flat tip. The projection is flattened out but does not quite fill up the volume originally displaced. *Fig.* 3 shows the proportions of projections before and after welding as used by some manufacturers. If projection welding is to be done on a welding machine where no great increase of pressure is available for a follow-up squeeze, the height should be less than in the foregoing.

The strength of a good weld will cause the metal to tear when forcibly separated. Thus in metals where the structure is not greatly modified by the welding temperature, the joint may be made as strong as desired by putting in as many spots as are necessary. This joint never slackens.

Metals and combinations of metals which can be spot welded are tabulated in *Fig.* 4, a list prepared by Bell Telephone Laboratories. Some of the welds can only be made by a special technique requiring alloy welding tips, welding machines which supply large currents for a very short time, and carefully graduated welding and forging pressures. The metals which may be regarded as standard for spot welding are steel, stainless steel, brasses and bronzes in rolled form, the coated steel stocks, all metals which have a fairly high electrical resistance. Thin copper and aluminum sheets if coated with vaseline may be welded on a standard machine

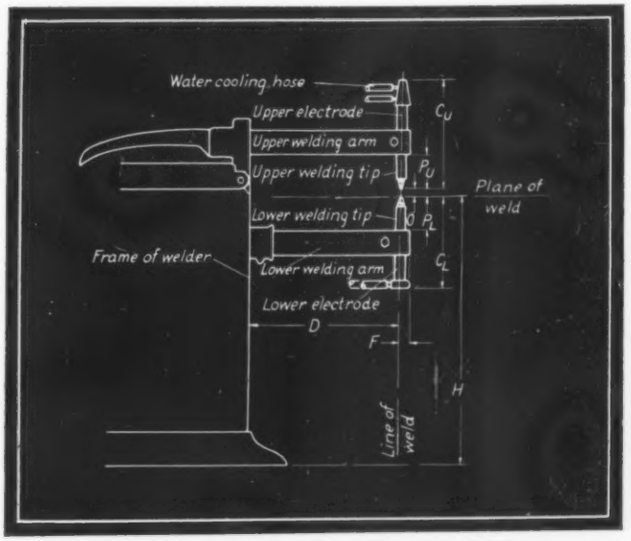


Fig. 6—When designing for welding by a standard machine, dimensions of that machine should be kept in mind

equipped with high resistance welding tips. The oil acts somewhat as an insulator except where the pressure is concentrated under the tips.

Coated ferrous sheets include galvanized iron, tin plate and terne plate. All are welded on standard welding machines with copper electrodes, though an alloy electrode which does not combine with the coating is preferable. The welding pressures must be adjusted so that the resistance offered by the surfaces in contact is sufficient to burn off the coating while the steel is being heated to welding temperature. This extra heating also requires extra KVA seconds so that a machine rated for clean steel stock should not handle more than seventy five per cent of this rating in coated stocks For very heavily coated light gage stocks, this derating may be down to fifty per cent.

Presents Nonferrous Welding

Nonferrous metals having high electrical resistances may be handled by a welding machine of proper capacity using alloy welding tips which will not combine with the metal of the work. Low resistance metals in very thin sheets may be welded by high resistance tips where much of the heat generated is in the tips themselves and is carried to the welding point by conduction. Pressure adjustment and the presence of oil on the surfaces in contact are also of great assistance.

Thick Aluminum Welds

Thick aluminum sheets are now welded using heavy pressures and large welding currents which flow for a very short time. Special welding controls which meter the time of heating in terms of half cycles of a sixty cycle power circuit are employed. Such control of heating is successful and solves the problem of generating only enough heat to bring the metals to plastic temperature. The range between plastic condition and molten condition is small for these metals, and to strike it exactly requires most critical adjustment of all factors.

Maximum thicknesses which can be spot welded are set up by the practical consideration of cost. The weights to be handled must also be taken into consideration, and the limit should probably be set at two pieces of steel one-half inch in thickness. Even here the heavy pressures, needed to make the weld, cause distortion of the copper welding tips, and necessitate their frequent replacement. The limit as to minimum thickness is the ability of the welding machine to control the heating, and the degree to which the articles may be distorted. This distortion is noticeable on a piece ten-thousandths inch thick. Strips of .001 shim stock have been joined together. The small parts of radio tubes also are welded; sometimes by using a measured quantity of electricity which is stored in a condenser.

Parts for welded assembly should be dimensioned for use in standard welding machines.

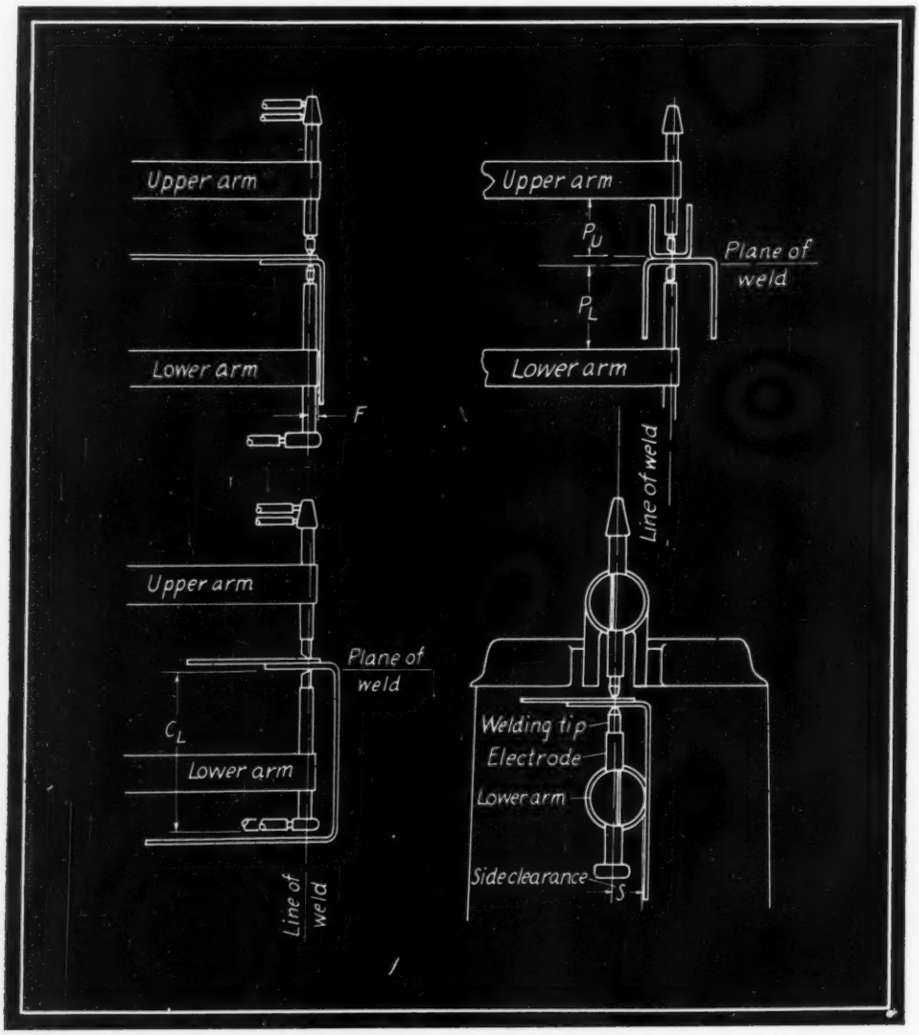


Fig. 7 — Limitation of space between the arms and necessity of removing work after welding impose limits on the location of welds

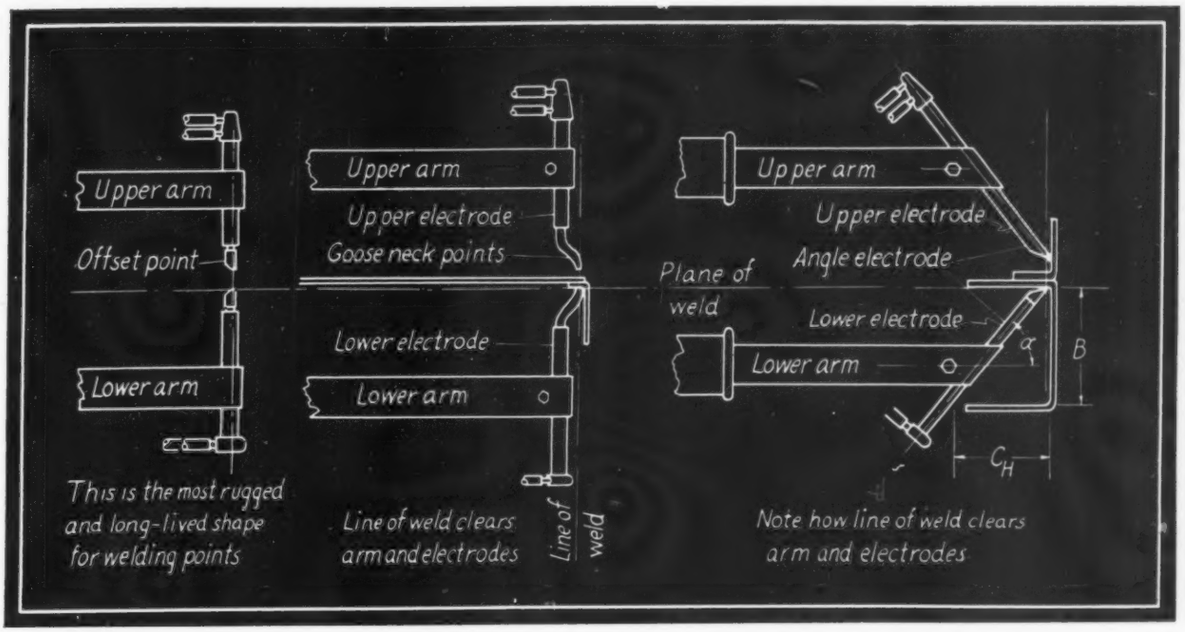


Fig. 8—Side clearances necessary in spot welding may be reduced by the use of special welding tips such as offset points, gooseneck points or angle electrodes

These machines are all very similar for similar sizes and consist of frame, step down transformer and electric control, pressure applying mechanism, welding arms, electrodes and welding tips. *Fig.* 6 is a sketch of the assembly of arms and electrodes in elevation and shows the dimensions which should be kept in mind when designing for welding.

Plane of weld is a horizontal plane resting on the top of the lower welding tip. Line of weld is a vertical line through the center of the welding area. The weld is made at the intersection of the line and plane.

The lower arm, and lower welding tip is usually stationary except for adjustment. The upper arm moves in a vertical plane to offer an opening between the welding tips. This is dimension *O* and it must be possible to insert the work between the tips and withdraw the welded assembly through this opening, unless it can be slid out sideways.

Line of Weld Located

Line of weld is located at a dimension *D* from the frame of the welding machine and gives the distance from the inserted edge of the work at which a weld may be made. This dimension *D* is known as the throat depth of the machine and is always included in the descriptive specification of a welding machine.

Dimension *F* is the front clearance and indicates the minimum distance from a vertical surface to the line of weld. *Fig.* 7, upper left, indicates just how this may be a limitation in the welding of a flat to a flanged piece.

The inward projections of the welding tips give the dimensions from the welding arms to the plane of weld. *Fig.* 7, upper right, indicates just how these dimensions must be used if a bracket is to be welded to the bottom of a box. In such case withdrawal of the assembly through dimension *O* must be checked.

Overall clearances C_l and C_u are very important if the welding of pipe or box sections is contemplated, as illustrated in *Fig.* 7, lower left.

Height of the plane of weld from the floor is usually adjusted for convenience in handling the work. This is dimension *H*, *Fig.* 6, and in the welding of large boxes it may have to be considered.

Describes Side Clearance

In the making of spot welds where the work has a vertical projection parallel to the welding arms there is a limitation in the front of a welding machine, *Fig* 7, lower right. It can be seen that the welding area is obtained by tapering a three-quarter inch diameter rod which is mounted in a one-inch diameter electrode, which again is mounted in the arms which may be two inches in diameter. Thus there is a minimum permissible distance of one inch between the line of weld and the vertical projection of the work. This is known as side clearance *S*.

The two clearances, side clearance *S* and front clearance *F*, are sometimes very awkward. They may be greatly reduced by the use of special welding tips, such as the offset points illustrated in *Fig.* 8, left, or the gooseneck points in *Fig.* 8, center. Another useful arrangement eliminating the front clearance *F* and providing a useful horizontal clearance back of the line of weld is shown in *Fig.* 8, right.

Don't Underrate Your Bearing Problems!

By Harold B. Veith

THOUSANDS of dollars are lost every year due to bearing failures, traceable to negligence in design or maintenance. Generally speaking, there are no short cuts in the specification of bearings. Each problem must be weighed carefully in the light of good practice. Any tendency to slight the smallest detail will more often than not breed trouble, and designers cannot afford to overlook the fact that a machine is no better than its bearings.

Over and above those factors that commonly are taken into account in the selection of sleeve bearings, such as dimensions, grooving and finish, lubrication and choice of bearing material, are the operating characteristics of the machine. This will be seen clearly from the discussion of specific cases cited in later paragraphs. The practical data presented should be of assistance to engineers confronted with similar plain bearing problems.

Boundary Dimensions Important

In most instances where bearing manufacturers are called upon to make recommendations for a bearing metal the size of boundary dimensions have been determined previously. Usually the proportions furnished by designers are too generous which, instead of increasing the factor of safety, are detrimental. In certain cases, of course, the design of the machine makes it necessary that the bearing be out of proportion.

It sometimes has happened that the machine builder has failed to give due regard to strength in the design of bearings. Such was the case with a bearing put into service by an old-established machinery manufacturer. The part that caused trouble from the start was a split bronze bushing 12 inches long, supporting a journal 6 inches in diameter. Maximum thickness of the bushing was $\frac{3}{8}$ inch, being recessed on its back to a depth of $\frac{1}{8}$ inch, leaving a thickness for the larger part of the bearing of only $\frac{1}{4}$ inch.

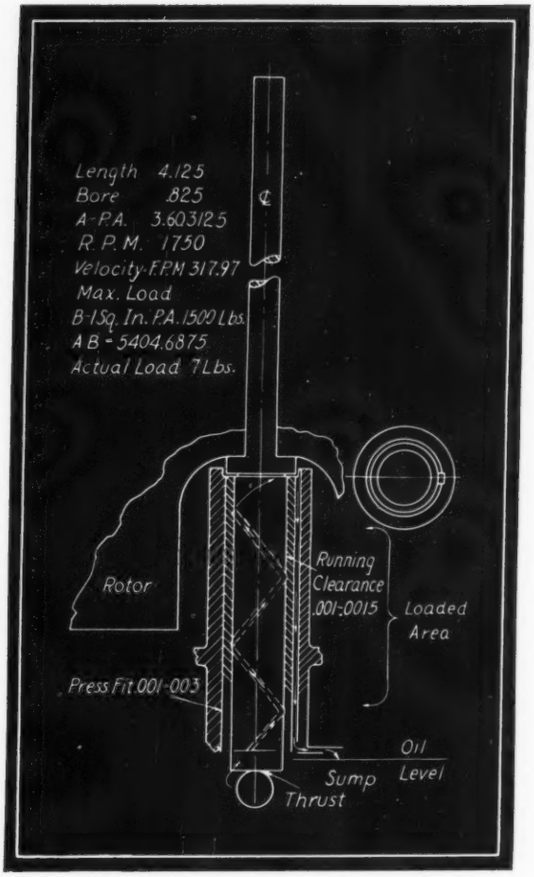


Fig. 1—By using this leaded bronze bearing momentary zero lubrication is possible

The cap of the bearing was held down by ten $\frac{5}{8}$ inch studs, the pressure of which distorted the bearing surfaces. Also, the thickness of the recessed and unsupported portion of the shell was not sufficient to withstand distortion under a normal oil film pressure. Trouble arose therefore, due almost entirely to the fact that the design was too light. An examination of this bearing after short service revealed that the journal had scored along four circumferential lines corresponding to the four supporting edges beneath the bearing.

A successful application involving the majority of the factors outlined in the second paragraph of this article is depicted in *Fig.* 1. This is a single bearing vertical electric motor with a balanced fan on the upper end of the shaft. Bearing length is necessary in this case due to a groove in the housing at the back of the bearing for oil return. Otherwise two 1-inch bearings at the top and bottom would have been

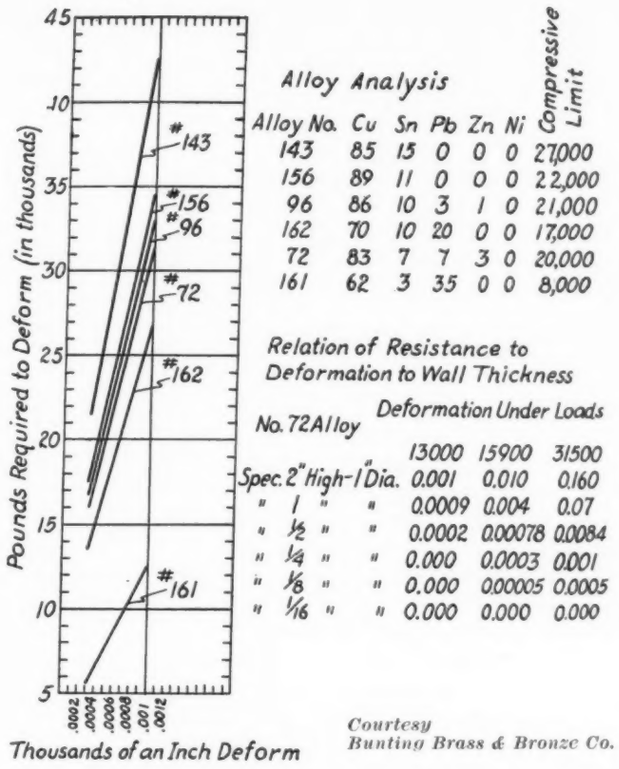


Fig. 2—Deformation chart showing results obtained with a one-quarter inch specimen

suitable with a helical groove cut in the shaft to help move the oil upwards. In the accepted design the bearing groove stops ½ inch from the top to retard oil spill. Specifications in this case called for grinding and lapping the shaft and diamond boring the bearing in place with a running clearance of 0.001—0.0015 inch.

Press fit of the bearing in the housing is 0.001—0.003. Precautions are taken to prevent permanent set caused by excessive press fit. The material specified is a leaded bronze, this being employed because the unit may have long periods of rest. Momentary zero lubrication also is possible, one of the deciding points in the selection of this material.

Another case study, disclosed the solution of a problem that arises when the operating characteristics of the machine involves reversal of the shaft, is depicted in *Fig.* 3. The first step is the laying out of the high pressure area. It will be noted that it changes with each reversal in the direction of shaft rotation.

Area *A* indicates the high pressure area when the shaft is turning anticlockwise. Centerline of the shaft moves over to the left and the shaft rises, this being caused by the shaft attempting to climb the bearing wall and also by the pull of the belt. The high pressure area with the shaft rotating in a clockwise direction is indicated at *B*. Climb of the shaft on the right bearing wall is restricted by the load and belt pull, inasmuch as the belt tension increases when the shaft movement is clockwise.

Since in this case the proportions of diameter to length are high, and to prevent bell mouthing of the bearing by shaft flexing, wall thickness is reduced to ½ inch. The alloy, designated Bunting 161 (see *Fig.* 2 for analysis), is particularly adaptable to cases such as this where lubrication is momentarily interrupted. Velocity of the shaft is 1767 feet per minute and a maximum load of 450 pounds per square inch is allowed. The bearing has a projected area of 60 square inches and maximum carrying capacity of 27,000 pounds if lubricated correctly. Total load is 3850 pounds and the factor of safety is high.

Side Wall Thickness Reduced

In designing the bearing for this application the only change made in dimensions was to reduce the side wall. If it had been a new design the length of the bearing could be 4 inches with a projected area of 30 square inches, thereby furnishing a maximum carrying capacity of 13,500 pounds. The bearing is a perfect half, diamond bored, and the shaft is ground to prevent oil shear.

One of the significant features of the foregoing bearing problem is the grooving, important because of the reversal in the direction of the shaft. It is necessary to spread the lubricant across the bearing area as close to the approach of the high pressure area as possible. To do this the bearing is chamfered at the parting line 3/16 inch deep and ½ inch wide, the ends of the chamfer being ¾ inch from bearing ends. Two ½ inch holes are drilled into this chamfered area in the top half of the bearing and oil is fed to them from an annular groove on the outside diameter which can be ¼ x ¼ or ⅛ x ½ inch, either dimension making a groove with an area

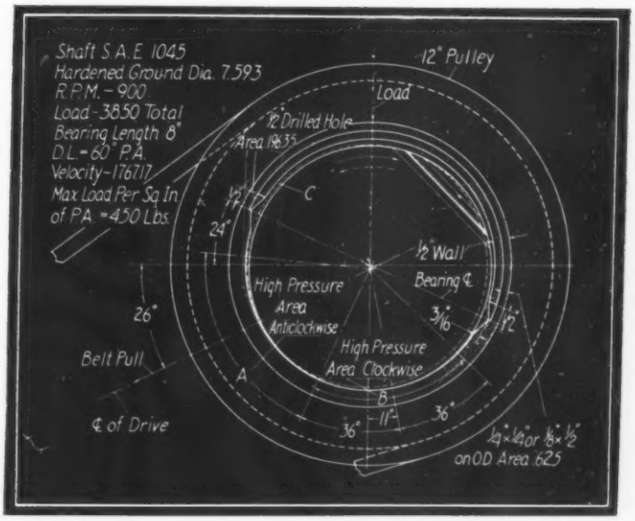


Fig. 3—Design of bearing was influenced by the shaft reversal which intermittently changed the high pressure area

of 0.625 inch to feed the two holes.

The bearing halves are placed in the housing with the parting line 24 degrees off center. This provides two sumps, either one at the approach to the high pressure area regardless of the direction of rotation. Inlet area is 0.6050 inch. Since the area of the two ½ inch drilled holes is 0.3927 and the area of the end spill is 0.1504, the sum of these subtracted from inlet area of

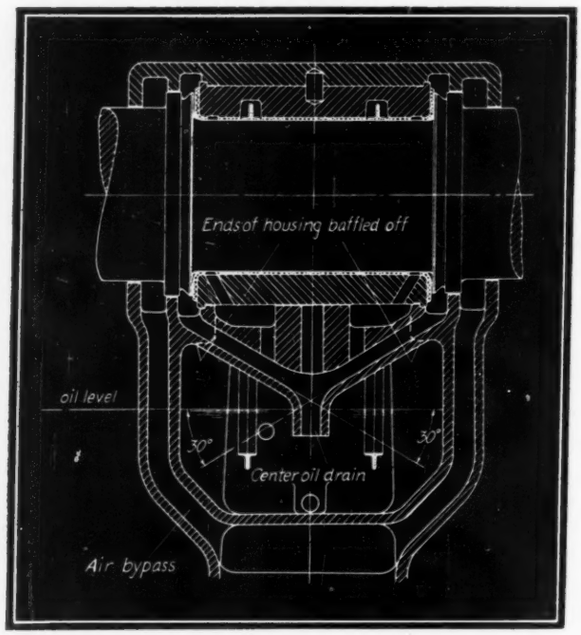


Fig. 4—Special sleeve housing prevents escape of oil during axial inclinations as great as thirty degrees

0.625 gives 0.0819 as the surplus for the oil volume.

In connection with the discussion of lubrication of bearings, attention is drawn to a special sleeve bearing housing that has been designed to accommodate large axial inclinations. Oil ring lubricated sleeve bearings sometimes are employed where it is necessary to incline them axially a considerable number of degrees. Movement back and forth through a wide arc causes the oil to swish from end to end in the housing. These conditions exist in particular on the bearings of generators mounted in the cabs of excavating shovels.

Assures Adequate Lubrication

To meet the requirements of this type of service the design, *Fig.* 4, was conceived for preventing the escape of oil at the housing ends at the point where the shaft comes through. The housing in this case is tipped axially to 30 degrees.

By baffling off the ends of the housing as shown, escape of oil is prevented. Moreover, the oil level is made low. Drainage from the ends of the bearings is carried back to the center of the housing where the oil level always is the lowest regardless of the amount of axial tilt. With this system of drainage lubricant cannot escape by splashing up through the drain holes as in the ordinary arrangement.

Bushings Graphite Impregnated

The comparatively recent development of cast bronze bushing impregnated with graphite deserves mention here. Dovetailed grooves of approximately 1/32 inch in width are cut into the bearing surface longitudinally on an angle of seven degrees. Spacing of these slots close together gives a mechanical structure similar to the alloyed granular structure of a hard and a plastic bearing metal. Any bronze alloy suitable for conditions under which it is to serve may be employed for this new self-lubricating bushing.

While the specification of sleeve bearings lies entirely with the designer, it is of course desirable to work with the technical staffs of the various manufacturers of bearings and bearing alloys. In this way full advantage is taken of the tremendous progress that has been made in the development of materials for this type of part. Investigations have been carried on ex-

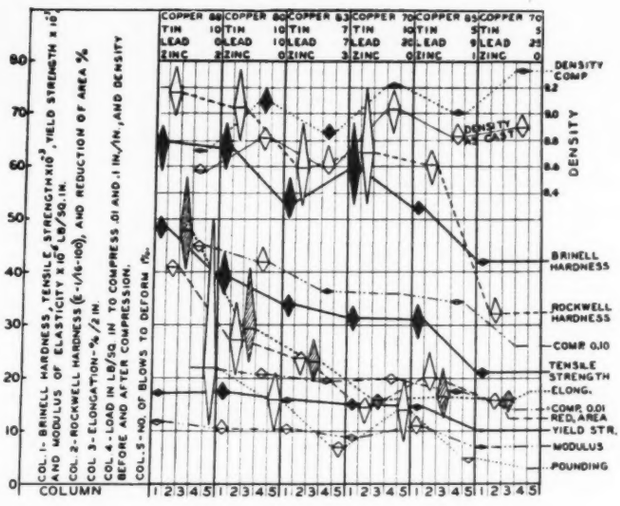


Fig. 5—Range of physical properties of six bearing bronzes investigated at room temperature

tensively to check physical properties, for example. The chart, *Fig.* 5, shows the results of one phase of this research activity with respect to the range of properties which in this case cover six well-known alloys used in bearing design.

For their co-operation in the preparation of data presented in this article MACHINE DESIGN thanks the Bunting Brass & Bronze Co., Toledo, O., Federal-Mogul Corp., Detroit, Johnson Bronze Co., New Castle, Pa., Lumen Bearing Co., Buffalo, and Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

New Machines Indicate Design Trends

NOISE in machines no longer can be tolerated. There was a time when purchasers expected their equipment to be noisy, but today every user points with pride to his quietest and smoothest-running units. This desire for quietness is being reflected in the newer machines that are carefully balanced, are mounted on vibration isolating bases, or have interior surfaces lined with sound absorbing sheets.

This problem of noise is of particular importance in welded structures. In these designs drumming is liable to become objectionable unless steps are taken to eliminate it. One of the most common means of obviating drumming is to design ribs for the larger flat surfaces. Holes in these surfaces tend to break up the area. A recent trend is the inclusion of isolating material on the inside of the machines, the material being applied in a number of different ways.

Machines recently announced in addition to those on the next two pages include the following, arranged by fields of application:

Chemical

Vibrating Feeder,
Jeffry Mfg. Co.,
Columbus, O.

Magnetic Separator,
Separations Engineering Corp.,
New York.

Laborator Crushers,
American Pulverizer Co.,
St. Louis

Materials Breaker,
Cochrane Corp.,
Philadelphia.

Construction

Patch Roller,
Galion Iron Works,
Galion, O.

Domestic

Vacuum Cleaner,
Eureka Vacuum Cleaner Co.,
Detroit.

Air Conditioning and Heating Unit,
International Boiler Works,
East Stroudsburg, Pa.

Finishing

Plating Machine,
Udylite Corp.,
Detroit.

Flat Spray Machine,
O. Hommel Co.,
Pittsburgh.

Foundry

Abrasive Cut-Off Machine,
West Co., Inc.,
Philadelphia.

Automatic Sand Slinger,
Beardsley & Piper Co.,
Chicago.

Industrial

Ceiling Mounted Circulating Fan,
Chelsea Fan & Blower Co.,
New York.

Vibratory Screen,
Paterson Engineering Co.,
Philadelphia.

Dust Filter,
Ruemelin Mfg. Co.,
Milwaukee.

Materials Handling Truck,
Baker-Raulang Co.,
Cleveland.

Metalworking

Hydraulic Press,
Charles F. Elmes Engineering Works,
Chicago.

Motor Driven Drill Grinder,
Hisey-Wolf Machine Co.,
Cincinnati.

Autobody Panel Forming Press,
Lake Erie Engineering Corp.,
Buffalo.

Portable Drill,
Rotor Air Tool Co.,
Cleveland.

Thread Grinding Machine,
Triplex Machine Tool Corp.,
New York.

High Speed Press,
E. W. Bliss Co.,
Toledo.

Bench Type Nibbling Machine,
W. J. Savage Co. Inc.,
Knoxville, Tenn.

Bending or Curving Rolls,
Geo. Whiting Co. Inc.,
Chicago.

Mining

Automatic Coal Washer,
Pittsburgh Coal Washer Co.,
Pittsburgh.

Percussion Type Sinker Drill,
Chicago Pneumatic Tool Co.,
New York.

Power

Diesel Engines,
Cooper-Bessemer Corp.,
Mt. Vernon, O.

Printing

Bag Printing Machine,
Jas. H. Matthews & Co.,
Pittsburgh.

Refrigeration

Crushed Ice Maker,
Vilter Mfg. Co.,
Milwaukee.

Restaurant

Potato Peelers,
Reynolds Electric Co.,
Chicago.

Textile

Finishing Calendar,
Textile-Finishing Machinery Co.,
Providence, R. I.

Warp Conditioning Unit,
Charles B. Johnson,
Paterson, N. J.

Spiral Wrapping Machine,
Terkelsen Machine Co.,
Boston.

Wet Finishing Machinery,
Riggs & Lombard,
Lowell, Mass.

Single Package Extractor,
American Tool & Machine Co.,
Boston.

Welding

Medium Pressure Generators,
Linde Air Products Co.,
New York.

Vertical Arc Welder,
J. D. Adams Co.,
Indianapolis.

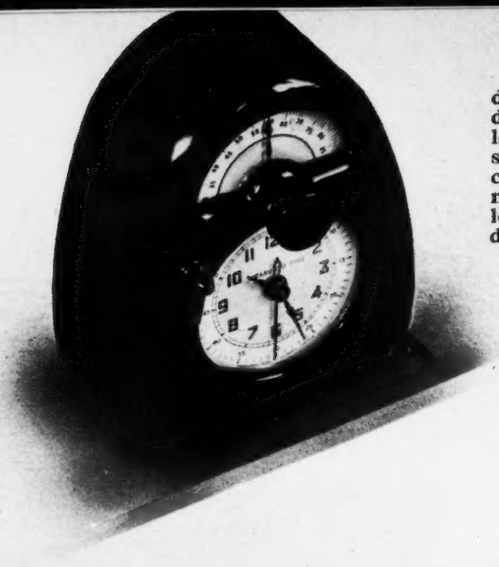
Portable Radiograph,
Air Reduction Sales Co.,
New York.

Woodworking

Universal Circular Saw,
J. D. Wallace & Co.,
Chicago.

Tilting Arbor Saw Benches,
Tannewitz Works,
Grand Rapids, Mich.

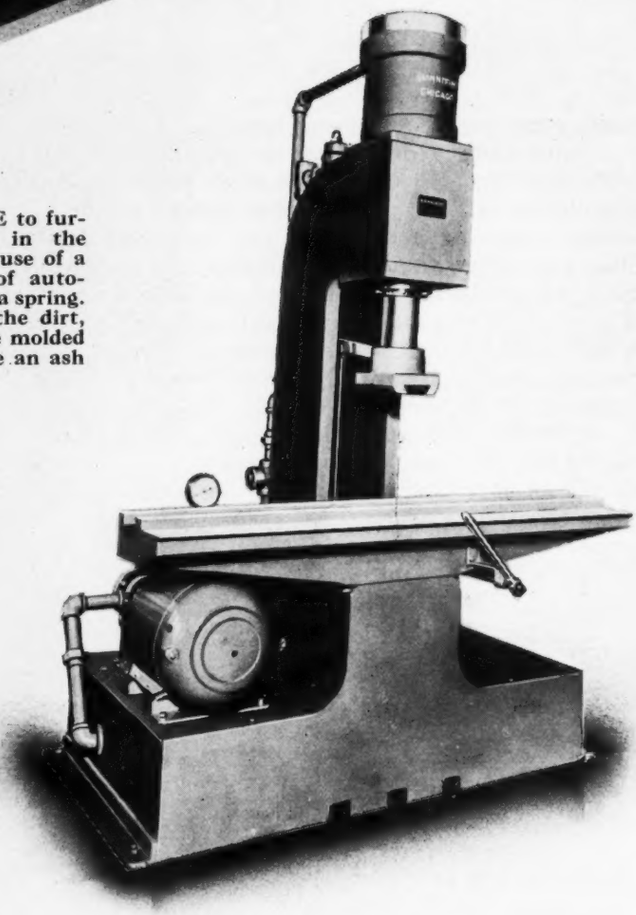
Self-Adjusting Rack Sander,
J. M. Nash Co.,
Milwaukee.



FOR precision timing of definite intervals, Measured Time has designed an electrical interval timer, left. Bakelite molded is employed to secure an acid resistant and dielectric case of lustrous black. A buzzer, which may be adjusted either loud or soft, long or short, indicates when the predetermined interval has expired.

APPEARANCE in k
equipment being moved is built in
tractor for airport use, above. Th
compacted so that the tractor ca
wing monoplanes. Controller fo
interlocked electrically with a mi
blow-out contacter in such a m
driver's seat must be occupied be
can be operated.

DAMAGE to furniture is eliminated in the Eletrikbroom, left, by use of a flexible nozzle made of automobile tire rubber over a spring. Instead of a bag for the dirt, the unit has a Bakelite molded cup which empties like an ash tray.

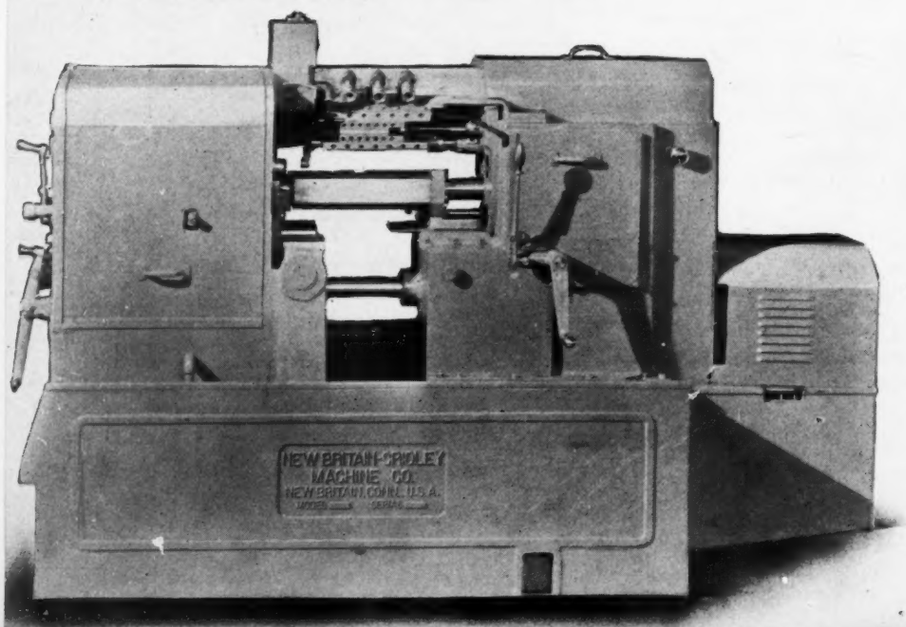


HYDRAULIC power unit, with constant delivery type rotary pump is built into the base of Hannifin straightening press, right. A single lever controls the operation. Arc of movement of the lever is approximately three times the ram stroke.

Design Fe
in New Ma

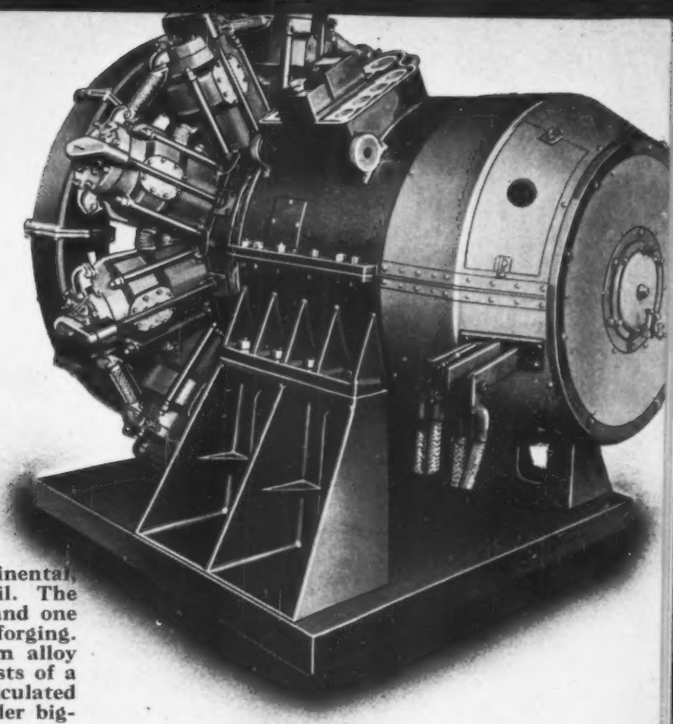
**A Pictorial Presentation o
from the Standpoi**

IT is impossible to operate New Britain automatic screw machine, below, until a predetermined oil pressure has been built up in the lubricating system. Spindles are mounted on preloaded ball bearings.



FRAME and nozzle of Pacific carpet washer, below, are of an aluminum alloy. The tank is of tinned steel; pump housing is bronze; trucking handle is formed from seamless steel tubing. The unit is self-propelled through a motor mounted inside of the case. Cleaning is both mechanical and chemical.

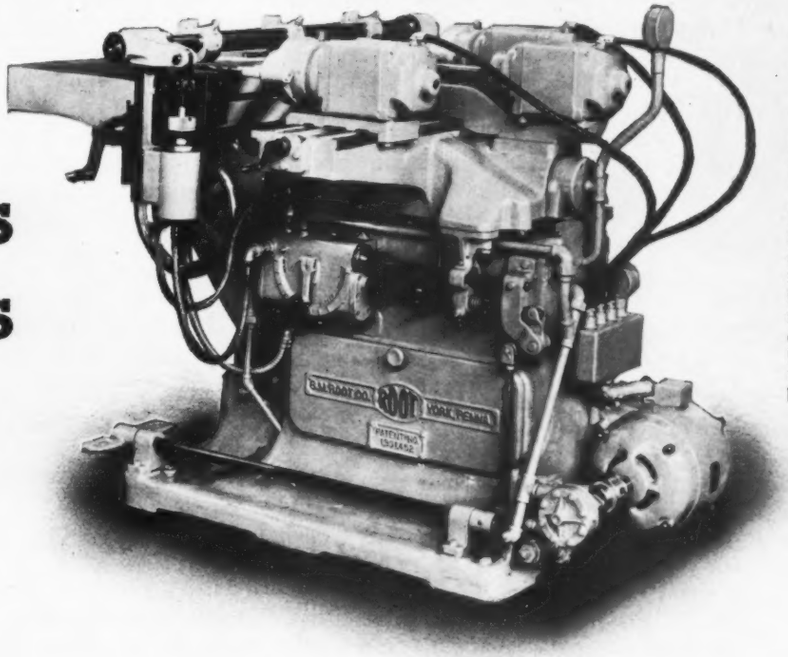
APPEARANCE in keeping with the ing moved is built into Baker electric port use, above. The design has been that the tractor can get under low nes. Controller for the tractor is ectrically with a mill type, magnetic tacter in such a manner that the nust be occupied before the machine d.



RADIAL diesel engines of Continental, right, have a crankcase welded of Cromansil. The crankshaft, mounted on two large roller and one ball bearing, is a nickel chrome steel forging. Scavenger blower housing is an aluminum alloy casting. The connecting rod system consists of a master rod of nickel chrome steel with articulated rods. The former is fitted with needle roller big-end and wrist pin bearings.

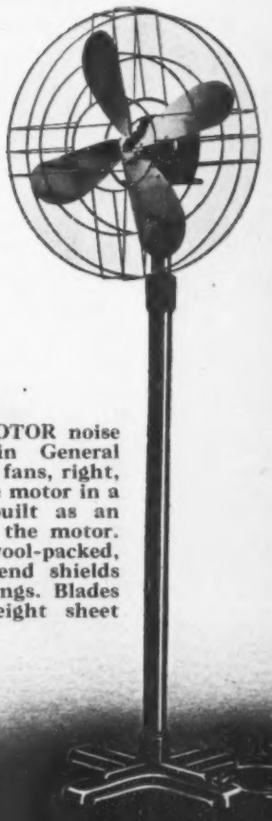
gn Features w Machines

esentation of Recent Machinery ne Standpoint of Design.



ELECTRIC and hydraulic controls are combined in Root borer, left, to give precision operation to the individually motorized boring spindles. Feed to the work and return is by hydraulics, while the work is clamped hydraulically. The hydraulic feed, electric spindles and reciprocating motion of the spindle rail are each individually controlled from push-button stations and protected by thermal overload elements.

RECIPROCATING speed and rotating speed are both infinitely variable in Hutto horizontal honing and lapping machine, above. Reciprocating motion is produced hydraulically and transmitted through mechanical gearing. Rotation drive is mechanical, including a motor, drive unit having combined selective gear and infinitely variable speed regulation. The base is of welded steel construction.



MOTOR noise is eliminated in General Electric pedestal fans, right, by mounting the motor in a resilient base built as an integral part of the motor. Bearings are wool-packed, and drip-proof end shields protect the windings. Blades are of light weight sheet aluminum.

MACHINE DESIGN

New Industries Cannot Be Established Without Aid of Machines

WHAT has happened to the furor regarding the supposed depredations of the machine? Where are those constantly recurring statements to the effect that the country was doomed due to its development of automatic high speed machinery?

Amazing figures—to some—are those revealed by a survey made by the National Industrial Conference Board. Eighteen new industries, that did not exist before 1879, employed one-seventh of all labor engaged in manufacturing activities in 1929. The automobile ranks first, with nearly half a million workers, electrical machinery second with 328,000.

These eighteen newer industries could never have been created were it not for the development and use of modern machinery. Most of us might now be living directly off the land and using oil lamps for light —with the radio, refrigeration and air conditioning, the airplane and automobile unknown except to the imagination.

Progress can be speeded even more, the comforts of present-day life can be increased, and the one-seventh figure of additional employment can be raised still higher by the introduction of more machines such as those that made these industries possible.

• • •

All Eyes on Machine Tools!

THOSE readers of MACHINE DESIGN who have not thus far learned that a special issue devoted exclusively to machine tool design is to appear next month, may ask "Why?"—in view of the fact that this journal is not wholely a machine tool or a production magazine.

Is it not true that the eyes of machine designers will be turned toward the Machine Tool congress in September? That manufacturers of all kinds of machinery will be "thinking" machine tools, by virtue of the immensity and importance of the exposition? And that alert design executives and engineers look to the machine tool field for ideas that have possible application in their own machinery?

Since its inception, MACHINE DESIGN has not devoted an issue to any one type of machine—all classes and all sizes have been covered. But under the foregoing assumptions, which we have every reason to believe are correct, it seems clearly evident that a machine tool issue will be eagerly absorbed. This number will treat the latest developments in machines, parts materials and processes, and will give readers a complete picture of the modern machine tool, its design and far-reaching influence

PROFESSIONAL VIEWPOINTS

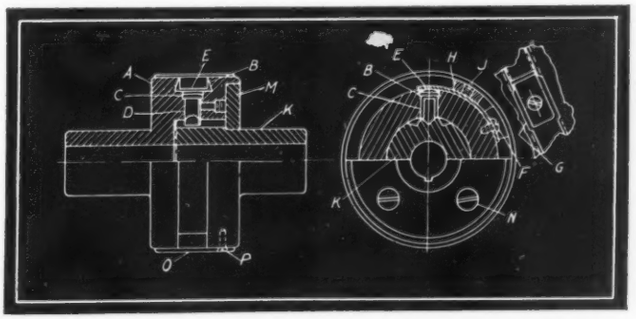
Machine Design Welcomes Letters Suitable for Publication

Overload Coupling Protects Machines

To the Editor:

IN DESIGNING drive mechanisms it is often required that some type of overload safety device be incorporated in order to protect the mechanism behind the input shaft from serious damage. If this overload device can be arranged so that with one design it is possible to cover a wide range of conditions, then manufacturing and inventory costs are reduced to a minimum.

The coupling shown in the accompanying illustration consists of housing *A* on the periphery of which dovetail groove *B* has been turned. Snap pin *C* is inserted in hole *D*. Above the snap pin



Overload coupling may be adjusted in a number of different ways to accomodate varying conditions

there is flat spring *E* held in place by screw *F*. At *G* a space has been milled out to allow dovetail clamp shoe *H* to enter groove *B*. This shoe is pushed forward and screw *F* inserted, thus preventing the shoe from coming out. In shoe *H* is clamp screw *J* to clamp this shoe in whatever position is desired.

Internal member *K* has a specified number of V-notches milled for a short distance near one end. The diameters are made a running fit in the housing and member *K* is kept from excessive endwise motion by means of clamp plate *M* which in turn is fastened in place by screws *N*.

To give the housing a smooth rotating surface steel shell *O* is slipped over the outside diameter and is held in place by screw *P*.

This coupling is truly universal. It can be adjusted by changing the angles of the pin and the saw-tooth internal member. It also can be adjusted by increasing or decreasing the thickness of the spring. It can be adjusted further by increasing or decreasing the number of pins in engagement. Finer adjustment can then be made by changing the distance of shoe *H* with respect to the pins.

—J. A. HONEGGAR,
New York.

Is Our Patent System Weak?

To the Editor:

IN SECURING a patent, the main purpose is to obtain for the inventor exclusive rights to use, manufacture and sell the invention. The fact that the number of patents granted recently has decreased, indicates that several things are wrong with our patent system.

Possibly the privilege of exclusive rights does not mean much. There are many ways of doing the same thing or getting the same results. Patenting one of these ways only ties up that one. Unless the inventor patents every way that he can think of, he cannot get the protection he desires. Even if he should patent every way he can think of, he is liable to miss a few possibilities. Therefore the exclusive privileges that he seeks may be valueless, because there are so many ways to get around his patent.

Proof of priority can make a patent almost worthless. Because of this fact, many inventors simply make out forms called a Record of Invention. They have these notarized and file them away. They then have priority protection, which is almost as good as patent protection. There are many cases where this type of protection is used to protect the inventor that does not need all the protection that a patent offers. It is true that proof of priority cannot be used to stop others from using the invention; it can be used when the inventor is being sued by one holding a patent.

Does a patent protect the inventor? Is it not true, that in case he believes his invention is being infringed upon he has to fight a case in court to protect his patent? The possession of patent papers does not protect the inventor's invention any more than the life-saving certificate owned by the life guard at the beach protects the bathers from drowning. The life guard still has to do the life saving and the inventor still has to do the protecting.

As a means of improving the patent situation,

may I make a few suggestions in the rough? I say, "in the rough" because I realize that these suggestions will not remedy all of the present weaknesses and they still need refining. I simply suggest them for consideration, discussion or comment.

Make all patents the property of the United States Government. The inventor submitting an invention to be patented will be granted the exclusive privileges that he now seeks. The patent being the property of the government, it will be their duty to protect the inventor from infringement. They will employ patent engineers and lawyers throughout the country to spot infringers and bring them to trial. Infringing will be a federal offense. It will be fought in federal courts, by federal men. The inventor will have nothing to do with the case.

—R. A. PERRETT,
Oak Park, Ill.

Mechanism Stops Wire Reel

To the Editor:

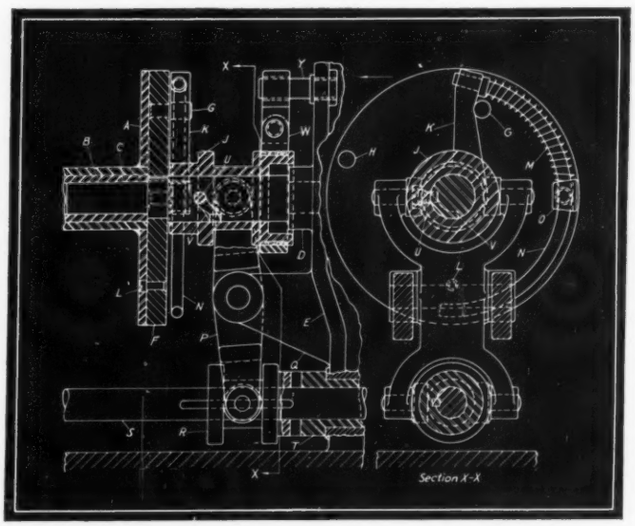
IN RE-REELING wire from large to small spools, provision is made for automatically stopping the reeling machine when the reel is empty and also if the wire breaks. The mechanism for obtaining this stop motion is shown in the accompanying illustration. The reel from which the spools are filled, *A*, is loosely mounted on cylindrical tube *B* in which journal *C* is a press fit. Journal *C* is supported in bearing boss *D* in stationary machine frame *E*.

Cast iron disk *F* is keyed to journal *C* and riveted to this disk are two pins *G* and *H* which limit the angular movement of sleeve *J* of which arm *K* is an integral part. This sleeve has a follower screw-pin *U* which engages a cam groove *V* for imparting axial movement to the sleeve; and is also equipped with an ordinary band brake *W* for providing tension in the wire as it is drawn off the reel.

Another pin *L* riveted to disk *F* enters a hole in the flange of the reel and locks both reel and disk together so that they revolve as one. Arm *K* is provided with spring *M* which is held to its curved contour by guide rod *N* passing freely through block *O* riveted to the disk. The opening in the top of arm *K* is elongated to permit free sidewise movement of the rod.

Double yoke lever *P* is pivoted to bracket *Q* on the machine frame, and its upper and lower ends are equipped with rollers. The upper roller engages a groove in sleeve *J* while the lower one enters a groove in jaw clutch member *R*, which is a sliding fit on, and splined to the shafts and engages mating clutch member *T*. Clutch member *T* is the driving member for transmitting motion through shaft *S* to the entire machine.

Assume that the reel is full and that the wire is being drawn off in the direction of the arrow. Now reel disk *F* and journal *C* are locked together and sleeve *J* is forced to turn with the members by pin *G* in contact with arm *K;* hence while the wire is being unwound a tension in the latter is set up by the torsional moment imparted by brake *W*. However, if the wire breaks, sleeve *J* and arm *K* will be held stationary by the brake and the wire tension will be released, allowing spring *M* to rotate the reel, disks and journal in the opposite direction until pin *H* comes into contact with arm *K*. This partial rotary movement of the journal will cause the cam groove to impart an axial



Mechanism stops wire reeling machine whenever the reel is empty or should the wire break

movement to follower pin *U* and sleeve *J* in a direction from left to right. As a result, the upper end of lever *P* will be swung to the right and its lower end will slide clutch member *R* to the left thus disengaging the clutch and stopping the machine. Obviously the same action of the mechanism takes place when the last coil of wire leaves the reel. To start the machine again, the wire is drawn tightly by means of a handwheel on the journal at the left end of the reel. In this way, the stop mechanism once more assumes the position shown with the clutch member *R* engaged.

In order to permit guide rod *N* to travel axially with sleeve *J*, the hole for the rod in the upper end of arm *K* is elongated. With this arrangement, the rod pivots in block *O*. Brake *W* also travels with the sleeve, and to facilitate this movement, the upper end of the brake is provided with an arm having a hole engaging stud *Y* in the machine frame. In this way the brake is free to move axially with the sleeve without rotating with it.

—F. E. JUDSON,
Belleville, N. J.

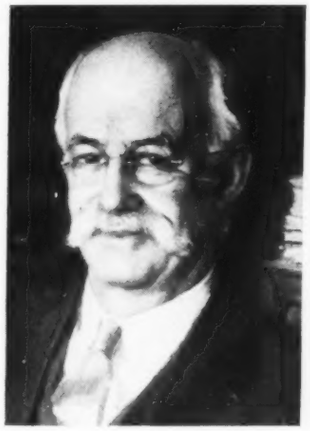
MEN OF MACHINES

FOR the past ten years a director of the American Welding society, John J. Crowe, now becomes its new president. His experience in the field of metals goes back to a period shortly after graduation from a Washington D. C. high school when he went to work at the bureau of standards. By 1915 he had advanced to associate physicist in charge of a section in the bureau,

It was at the Philadelphia navy yard that Mr. Crowe had his first real contact with the practical application of fusion welding and cutting by the acetylene process. In 1921 Temple university established a course in metallurgy and appointed him director of the department. Three years later he accepted the position he now holds—engineer in charge of apparatus research and development for Air Reduction Co.

JOHN J. CROWE

• • •



COLUMBIA university school of engineering loses one of its veteran faculty members with the retirement of Thomas Henry Harrington, professor of engineering drafting. He has been at that institution for forty years. Born May 30, 1866, Prof. Harrington gained his early education in a private school.

Matriculating at Columbia, he graduated from the school of Mines in 1889. His first work was with the United States engineers which took him to the Chicago Fair in 1893 where the government exhibited models of the Hell Gate project.

He forsook this government position in 1894 to return to Columbia, commencing a career which made him the best-known and best-loved figure on the campus. He became affectionately known as "Pop."

T. H. HARRINGTON

• • •

WELL known as an arc welding authority, A. M. Candy has accepted an appointment as consulting engineer on the staff of the Hollup Corp. in Chicago. He will be engaged in the development of welding machines and in research directed toward improved welding practice.

Mr. Candy holds a degree in electrical engineering from the University of Nebraska and has been associated with Westinghouse for a number of years. His work in the laboratories of that company involved the solution of electrical problems in connection with motion picture projection, storage battery locomotives and arc welding.

A dominant figure in the pioneering of arc welding, he figured prominently in the world's first multiple-story welded build-

A. M. CANDY

ing constructed in 1926 at the Westinghouse works at Sharon, Pa., the first arc welded railroad bridge, and other projects. Mr. Candy is a member of the American Institute of Electrical Engineers and American Welding society.

♦ ♦ ♦

MARTIN DODGE has become associated with WALTER DORWIN TEAGUE, well-known industrial designer of New York.

♦ ♦ ♦

T. W. KAESTNER recently was appointed chief engineer of Prima Mfg. Co. Inc., Sidney, O.

♦ ♦ ♦

CHARLES L. GERLACH now is chief engineer of Michael Yundt Co., Waukesha, Wis.

♦ ♦ ♦

COL. ELLIOTT H. WHITLOCK, A.S.M.E. vice president, recently was appointed head of the department of technology of John Huntington Polytechnic institute, Cleveland. He was formerly smoke commissioner of Cleveland and later served on the faculty of Stevens Institute of Technology.

♦ ♦ ♦

P. J. POTTER has been elected director and vice president of Pangborn Corp. and will be directly responsible for engineering, production and sales. Formerly second vice president, he has been associated with the organization for twenty years.

♦ ♦ ♦

DR. MATTHEW LUCKIESH, director of the General Electric lighting research laboratory at Nela Park, Cleveland, was the recipient of the degree of Doctor *honoris causa* at Purdue university recently. The honor was conferred upon him in recognition of his outstanding achievements in science.

♦ ♦ ♦

WILLIAM H. MEESE, vice president of the Western Electric Co., was the recipient of two honorary degrees in June. University of Michigan, his alma mater, conferred upon him the honorary degree of Master of Engineering, while Temple university presented him with the degree of Doctor of Science.

♦ ♦ ♦

W. M. MCCONNELL has joined the engineering department of Patterson Foundry & Machine Co. to take charge of the drafting room. He had considerable experience in the handling of process equipment and plant design while connected with Koppers Co. and the American Cyanamid & Chemical Corp.

♦ ♦ ♦

E. F. ROBERTS, vice president in charge of manufacturing of Packard Motor Car Co. and veteran of nearly forty years in the automobile industry, has resigned to retire from active business. He is credited with creating many important machines and processes now used in the industry.

♦ ♦ ♦

F. W. THOMPSON recently became director of research for the Four Wheel Drive Auto Co., Clintonville, Wis.

♦ ♦ ♦

C. A. HOGENTOGLER and E. A. WILLIS have been chosen as winners of the 1935 Charles B. Dudley medal awarded by the American Society for Testing Materials. This honor is conferred upon an author or authors of outstanding technical papers that constitute an original contribution to research in engineering materials.

♦ ♦ ♦

Avoid Waste of Material in Parts Design!

(*Concluded from Page* 25)

of the endurance limit S_{en} without a discontinuity to S'_{en}, the endurance limit with the discontinuity. According to the present theory, the failure starts with a minute crack at the point of the highest stress concentration and this crack acts as a notch, increasing the stress concentration at this point and causing final failure. Therefore, this ratio may be called by rights stress concentration factor[19]. Since it has a certain relation to the form factor k, but refers to repeated stresses, the designation k_r will be used. Thus

$$k_r = S_{en}/S'_{en} \quad \ldots\ldots (30)$$

The magnitude of k_r is found from tests. The latter show also that k_r depends greatly upon the material of the specimen.

It will take many years to determine k_r for all materials and all possible discontinuities. In the meantime, based on data already accumulated, for practical purposes k_r can be determined with a sufficient accuracy by the expression

$$k_r = 1 + q_r(k-1) \quad \ldots\ldots (31)$$

where the *sensitivity index*[20]

$$q_r = (k_r - 1)/(k-1) \quad \ldots\ldots (32)$$

is a measure of the sensitivity of the material to repeated stresses for various discontinuities.

Figs. 21 and 22 show values of k_r found experimentally for bending of bars with transverse holes and shafts with fillets and give the influence of the relative size of these discontinuities.

Other factors affecting the endurance limit of a material will be discussed in the final section of this article.

To be concluded in the September issue

[19]Supplement to *Z. V. d. Ing.*, No. 34, Aug. 25, 1934, pp. 2, 4.
[20]Peterson, R. E., *Trans. A.S.M.E.*, 1933, APM-55-19, p. 157 etc.

Obituaries

WILLIAM THOMAS MAGRUDER, professor emeritus of Ohio State university mechanical engineering department, died recently. He was seventy-four years old and had been ill for two months.

♦ ♦ ♦

ANDRE GUSTAVE CITROEN, prominent French automobile builder, died recently. He began producing a ten-horsepower car in 1919 along American mass production lines and acquired the distinction of being the "Henry Ford of France."

WHAT DOES

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Assets to a Bookcase

Practical Solution of Torsional Vibration Problems

By W. Ker Wilson; published by John Wiley & Sons Inc., New York; available through Machine Design; *price* $7.00 *plus* 15 *cents postage.*

Because the author has set down the principles and computation details of this subject in a manner suitable for everyday reference, his book provides a ready guide for the designer confronted with torsional vibration problems. The reader in search for specific information will be able to select data appropriate to his particular problem and from this build up a set of standard forms.

These are some of the subjects covered: Natural frequency calculations; equivalent oscillating systems; determination of stresses due to torsional vibration at nonresonant speeds—at resonant speeds; measurement of torsional vibration amplitudes and stresses; torsional vibration damping devices, etc. With the increase in importance of vibration control in design, the appearance of the book is timely.

□ □ □

Machine Designers' Guide

By K. W. Najder; published by Edwards Bros. Inc., Ann Arbor, Mich.; available through Machine Design; *price* $2.50 *plus* 15 *cents postage.*

This is another volume that belongs solely to the designer's library. Contents cover tables and construction of curves, mechanics, graphics, strength of materials and forty pages of examples apply to the data presented. The author compiled this handbook for the many working in the field of machine designing, who possess mechanical ability and who could acquire the facility of calculating if the subject were put in a clear and concise manner without involving higher mathematics. He succeeded in his aim admirably.

□ □ □

Engineering Drawing Manual

By Thomas E. French; published by McGraw-Hill Book Co. Inc., New York; available through Machine Design; *price* $3.00 *plus* 15 *cents postage.*

The appearance of the fifth edition of this well-known manual of engineering drawing is noteworthy. Revision was brought about largely by the fact that the American Standards association has completed its standards for drawings and drafting room practice. These and other pertinent A.S.A. standards which have been adopted since the last edition was published are given in the book and illustrations and drawings are made to conform to them.

□ □ □

Diesel Engineering Handbook

By L. H. Morrison and T. A. Burdick; published by Business Journals Inc., New York; available through Machine Design *for* $5.00 *plus* 15 *cents postage.*

In the seventh edition of this handbook the progress of diesel engineering has been capitalized by the editors to the utmost. An effective presentation has been made of a wide range of data assembled for the assistance of the engine builder, accessory manufacturer, engine purchaser, consulting engineers and plant operators. Designers whose work associates them in one way or another with any phase of diesel engineering will find the handbook helpful. With the increase in the use of the diesel, auguring as it does the beginning of a new cycle in our age of power, the publication of the revised edition is timely.

□ □ □

The Internal Combustion Engine

By D. R. Pye; published by Oxford University Press, New York; available through Machine Design *for* $7.00 *plus* 15 *cents postage.*

As a sequel to the author's earlier book which dealt with the basic principles of combustion and thermal efficiency in all types of internal combustion engines, this volume embodies the same method of treatment in dealing with the problems that face the designer of aero and other engines of high output. Chapters cover principles of air cooling, superchargers and the operation of supercharged engines, carburetors, lubrication and lubricants. Purely descriptive matter has been eliminated except where it is essential for discussion of principles.

Mr. Pye has had close contact both with research and aero-engine construction and is well qualified to survey critically the vast amount of recently published work and to treat in 368 pages those results which are most important to the designer. References are given to more than seventy original papers.

SILENT CHAIN EQUIPPED

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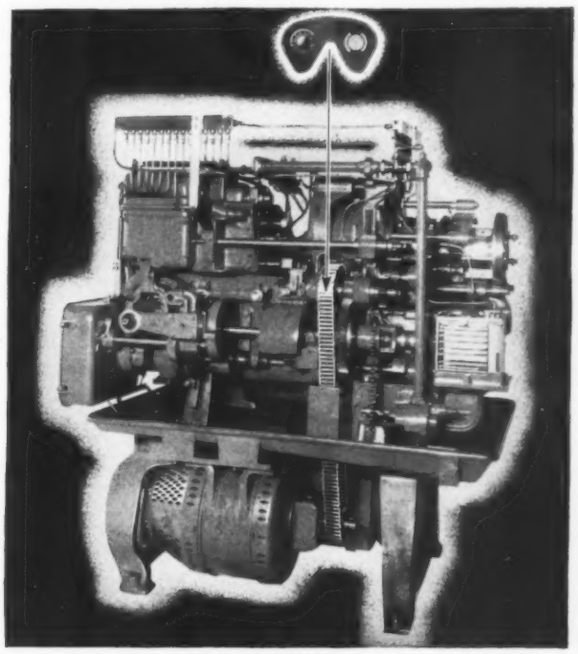

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TOPICS

STARTLING facts have been made public that relegate to oblivion all adverse criticism of the machine age as a creator of unemployment. A recent survey reveals that eighteen new industries have been created by advances in science, invention and technology since 1879. These absorbed almost one-seventh of all labor employed in manufacturing activity in 1929.

According to a report made by the National Industrial Conference board, the automobile industry occupies first place as employer of labor. In 1929 this industry gave direct employment to about 450,000 workers, one-half of whom were engaged in the manufacture of vehicles and the other half in producing motorcycles, automobile bodies and parts. The electrical machinery industry occupies second place with an employment of 328,000 workers in 1929. Manufacture of fountain pens comes last in the list with an employment of 4500 workers in that year.

• • •

Indications are that by September over eighty per cent of this year's graduating class of Cornell university will have found employment. By the middle of last June fifty per cent of the graduates already had been placed, the most encouraging record in four years. Forty per cent of the mechanical engineering graduates and thirty per cent of the electrical engineers already have been placed.

• • •

It remained for Auburn Motors in co-operation with Cummins Engine Co. to bring the diesel passenger automobile into commercial reality. A seven-passenger car has been developed to sell slightly higher than a gasoline engine powered model, but this differential will be offset by the saving in fuel oil. The car was driven from New York to the S.A.E. meeting at White Sulphur Springs, West Va., a distance of 498 miles, on thirteen gallons of fuel oil costing seventy-eight cents. Mileage was 38.6 miles per gallon of fuel.

The engine has removable liners for its cylinders, and cylinder heads are all in one casting. Nickel iron pistons carrying four rings are employed. Smokeless and practically odorless exhaust is accomplished by the use of an improved idea in combustion involving an air cell in the piston crown.

• • •

The 126-foot Boston sloop, YANKEE, scheduled to invade British racing waters this summer, has a mast made entirely of arc welded nickel steel. It is the first of its kind ever turned out in America. Her new racing rig was satisfactorily tested in a sail-stretching run recently.

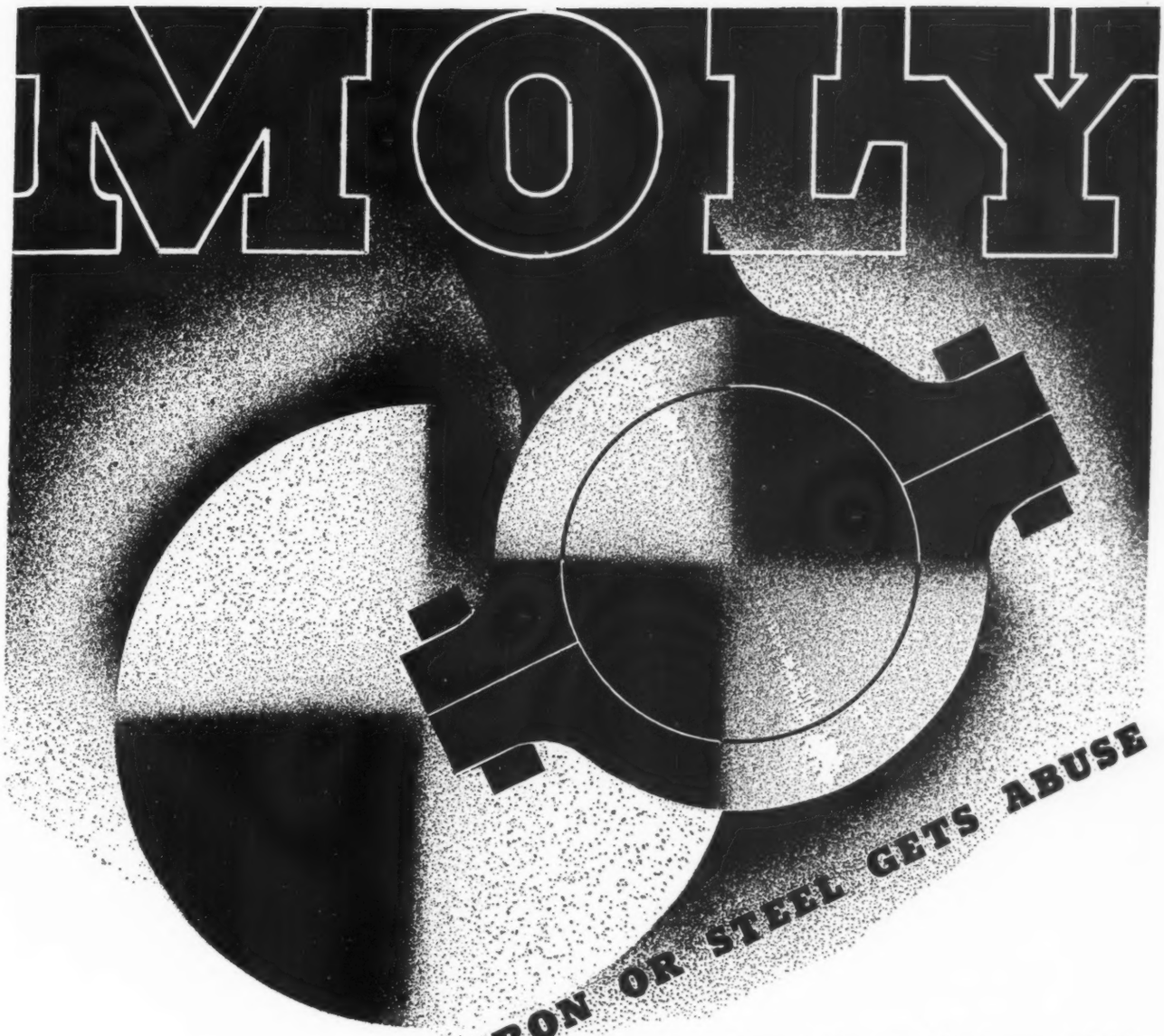
• • •

The grand old man of radio, modern electric power transmission and generation, Nikola Tesla was 79 years old last month. He celebrated his birthday by announcing that he would soon reveal to the world an invention that would solve a problem which electrical experts have been working on in vain for the past hundred years. Dr. Tesla, still full of enthusiasm, has more than 700 patents to his credit.

• • •

Streamlining, so-called, has entered the radio microphone field. A new non-directional dynamic device, shaped like a billiard ball and mounted on the top of a metal pipe or rod, has been designed by Bell Telephone Laboratories Inc. It is called the greatest advance in microphone during recent years and embodies a number of striking innovations.

The new "mike" treats sounds with equal fidelity without regard to direction of sound approach. By carefully working out proper mechanical proportions for a balance of acoustic forces, uniformity of response has been realized.

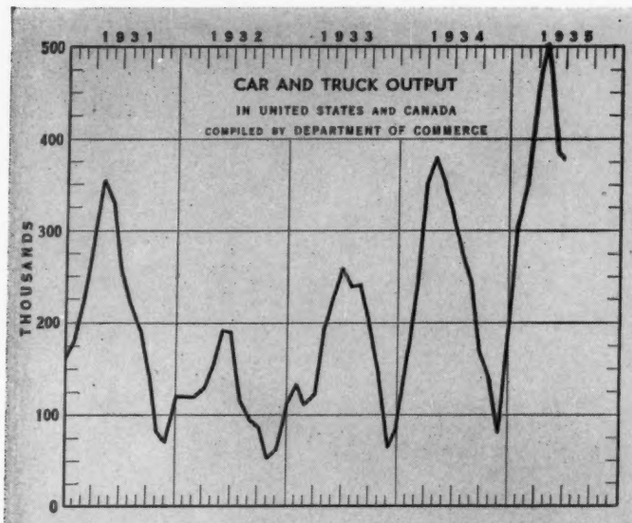


TORSION — like the relentless twisting of a heavily loaded crankshaft. IMPACT — like the incessant battering of a trip-hammer or pile-driver. HEAT — like the torturing temperatures encountered by boiler tubes and cylinder walls. . . . There are many types of steel, both alloyed and unalloyed, which will meet certain specified physical requisites for normal resistances to these enemies of metallurgy. But what happens to such steels when they are subjected to overloads? Often they fail — and usually their failure is dismissed with the conclusion that "nothing can be done about it." But something *can* be done to enable both iron and steel to withstand heavier abuses. And the most outstanding element in the recent development of this much-desired added quality is "Moly"— the alloy which not only improves ordinary iron and steel but which actually enables other alloys to do *their* particular work better.

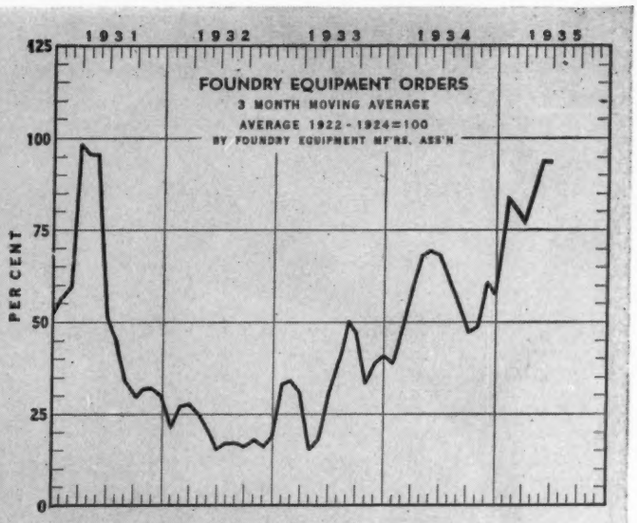
Interesting details about the properties of Moly irons and steels will be found in these two books which may be had for the asking: "*Molybdenum in* 1934" and "*Molybdenum in Cast Iron* — 1934 *Supplement*" . . . while current progress and specific examples of Moly applications may be followed through our periodical news-sheet "*The Moly Matrix.*" A post-card request puts you on our mailing list. And — if you've some particular alloy problem you'd like to have us help you solve, our metallurgists and Detroit experimental laboratory are at your command. Climax Molybdenum Company, 500 Fifth Avenue, New York. (In Canada: Railway & Power Engineering Corp., Ltd.)

CLIMAX Mo-lyb-den-um

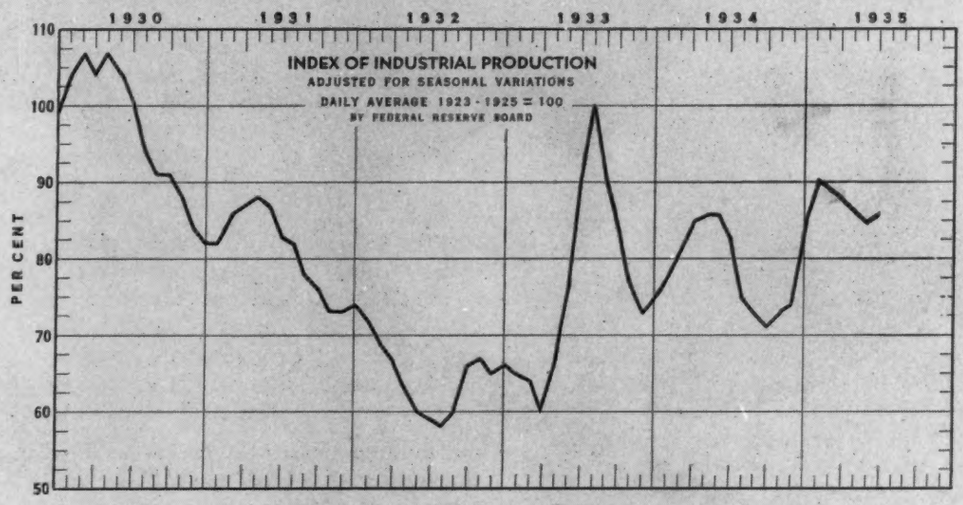
How Is Business?



June 1935, 377,065—*June* 1934, 320,382

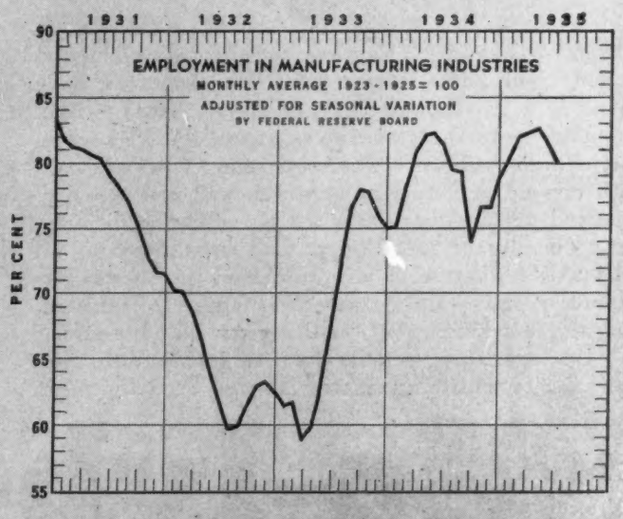


June 1935, 94.6—*June* 1934, 68.3

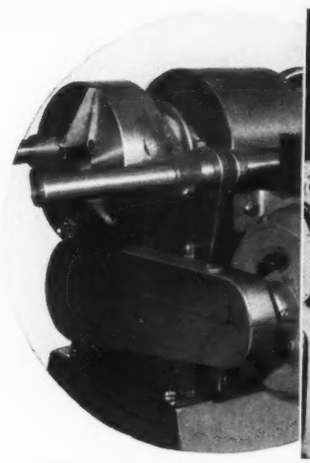


June 1935, 86—*June* 1934, 84

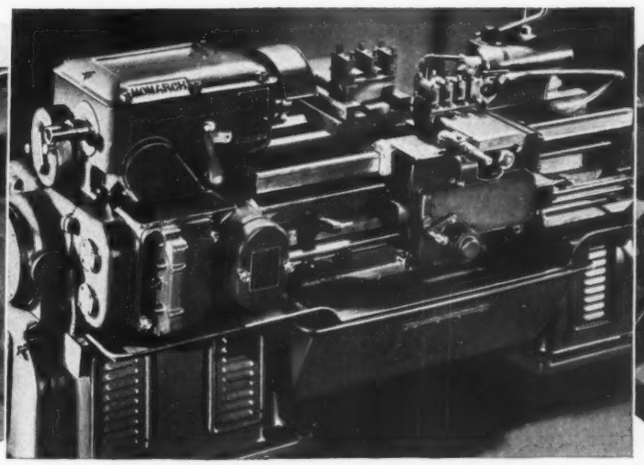
June 1935, 76.7—*June* 1934, 42.6



June 1935, 80.0—*June* 1934, 81.5



Toledo Pipe Threaders equipped with Diamond Roller Chains and sprockets:—Double-strand high speed chain on some models, and triple chain on others.



On the Monarch Automatic Lathe four single strand, one triple strand and one double strand Diamond Roller Chains are used.

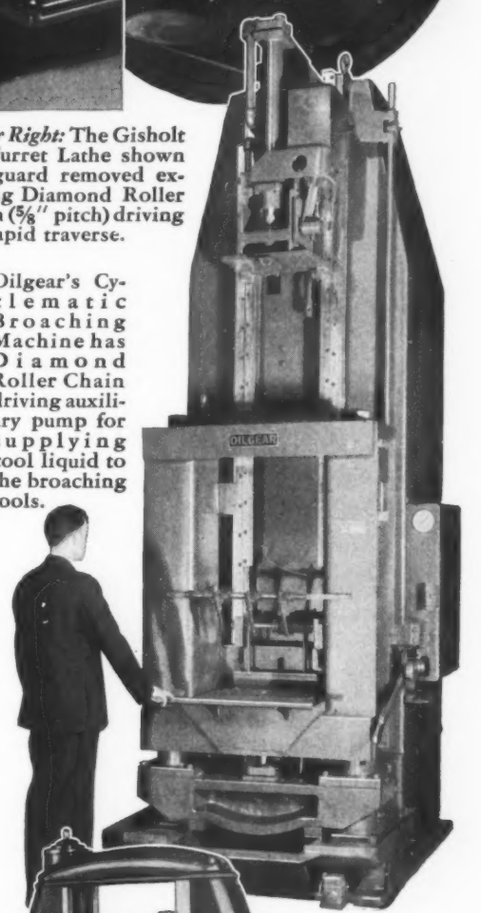
Upper Right: The Gisholt 2L Turret Lathe shown has guard removed exposing Diamond Roller Chain (⅝" pitch) driving the rapid traverse.

CHAIN DRIVES
MEET MACHINE TOOL REQUIREMENTS

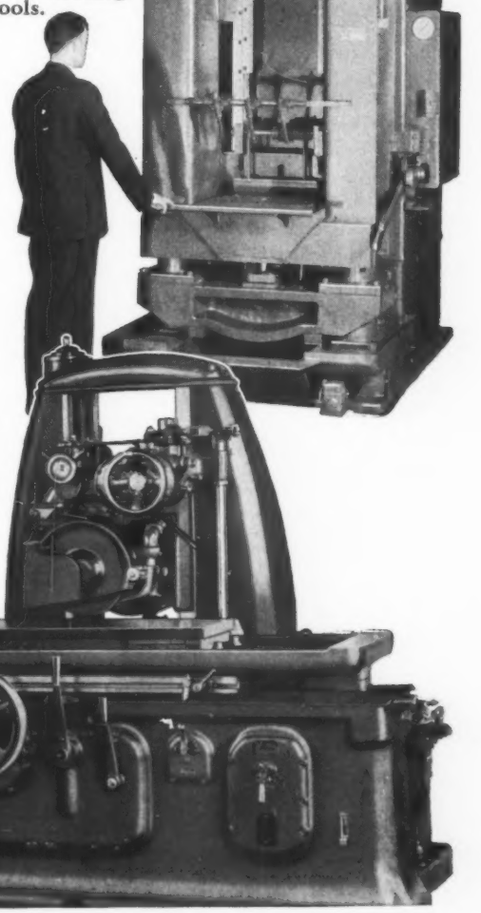
PRESENT-DAY advancements in machine tools and in chain design and manufacture have led to steadily increasing use of chains for motor drives, shaft to shaft drives and for auxiliary purposes.

The rigid requirements of machine tool operation have been met by Diamond Roller Chain drives—providing such advantages as—long life, quietness, higher maintained efficiencies, dependability, adaptability to short centers, and non-slip operation.

The illustrations show a few of the hundreds of machine tools on which Diamond Roller Chain is regular equipment. DIAMOND CHAIN & MFG. CO., 435 Kentucky Ave., Indianapolis, Ind. *Offices & Distributors in All Principal Cities.*

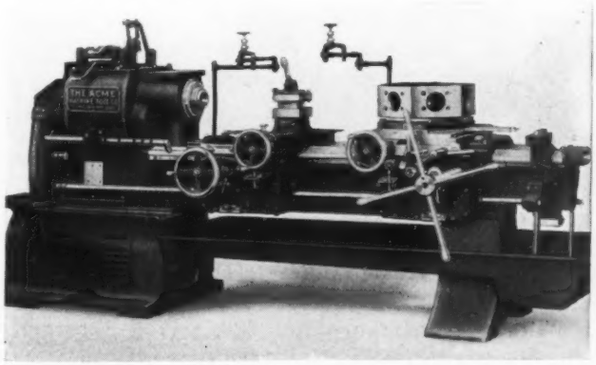


Oilgear's Cyclematic Broaching Machine has Diamond Roller Chain driving auxiliary pump for supplying cool liquid to the broaching tools.



Below: Mattison Machine Works are large and consistent users of Diamond Chains and Sprockets. On the 12"-14" Surface Grinder, 32½" of Diamond Roller Chain is used.

Below, Right: Cincinnati Acme Full Universal Turret Lathe.



DIAMOND ROLLER CHAIN

(B-3197)

NOTEWORTHY PATENTS

IN THE moving stairway, a relatively new type of transportation machine, the designer is given an opportunity to vent his ingenuity. One of the recent accomplishments is revealed by a patent recently granted for this type of mechanism. As the step unit 33, *Fig.* 1, while on the incline portion of the working run of the stairway, approaches the upper bend, tread wheel 38 of the unit engages upper landing tread wheel track 65. This track is shaped so as to support and maintain the step tread 34

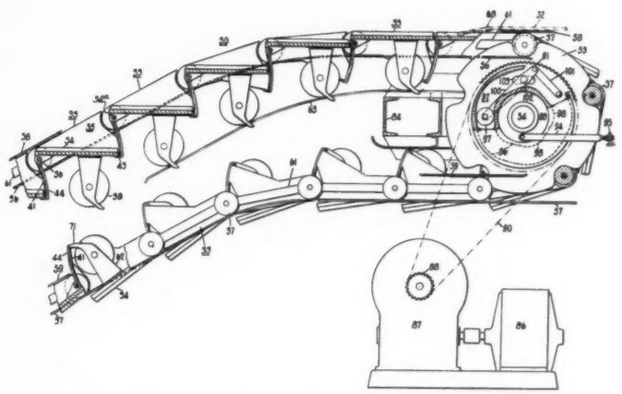


Fig. 1—*An endless series of step units hinged together are controlled by wheels riding on a track*

horizontal while on the working run of the stairway.

When the step unit traverses the upper bend and enters the upper horizontal portion, step thread 34 appears to rotate upwardly with respect to the sides of its step pocket. The actual movement, however, is a downward rotation of the sides of the step pocket relative to the step tread as the formation of the platform proceeds. Tread wheel 38 continues in engagement with track 65 after the step tread passes under combplate 68 at the upper landing. Track 65 extends around drive shaft 54 at this point so as to be engaged by the tread wheel as the associated step unit is transferred from the upper or working run to the return run. To assist in supporting track 65 there is mounted on the

underside of it where it is vertically above drive shaft 54, a roller arranged to bear upon the drive shaft.

At the upper landing 32 two stairway sprocket wheels are provided, one at each side of the stairway, being secured to drive shaft 54 as shown in *Fig.* 2. Each sprocket wheel is arranged to engage the cylindrical surfaces of step wheels 37 to drive the stairway. Motor 86

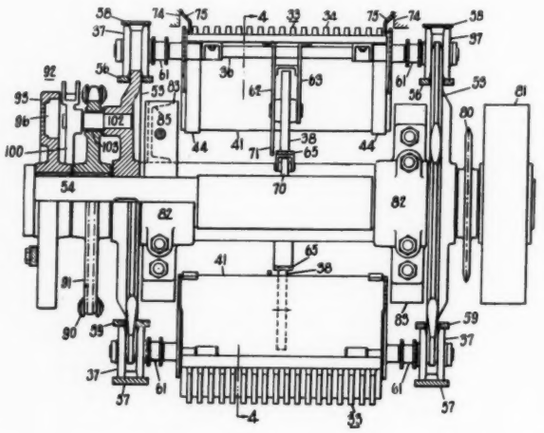


Fig. 2—Because of the relatively few teeth in the sprocket wheel a compensating drive is employed

through reduction gearing 87, *Fig.* 1, drives a chain which meshes with sprocket wheel 91 of compensating drive 92. This type of drive is provided in order to operate stairway sprocket wheels 53 at an angular speed which varies cyclically in such a manner as to reduce the variations in linear speed imparted to the step units incident to the employment of sprocket wheels such as 53 which have as few as five teeth.

In operation sprocket wheel 91 is driven at a substantially constant speed. Rotation of this sprocket causes rotation of linkage 100 and 101 about drive shaft 54 and thus causes movement of cam roller 97 in the five-lobed cam trough 96. Assuming the rotation of sprocket wheel 91 to be in a clockwise direction as shown in *Fig.* 1, cam roller 97 operates on the outer cam surface of the cam trough. Should cam trough 96 be a true circle, link 100 would not oscillate as sprocket wheel 91 rotates, and consequently the stairway sprocket wheels 53 would be rotated synchronously with sprocket wheel 91. Due however, to the irregular shape of cam trough 96, link 100 oscillates about driving pin 102 as sprocket wheel 91 rotates, and as such oscillation advances or retards stairway sprocket wheels 53 with respect to sprocket wheel 91, stairway sprocket wheels 53 are driven at a cyclically varying angular speed.

The patent for this mechanism was granted to William Sebastian Graff-Baker, Kensington, London, England, and assigned to Otis Elevator Co., New York. It is designated No. 2,005,067.

HANDLING of materials such as cellophane which is rendered unfit for use when it is creased or wrinkled, requires machines of unusual design. Typical is the apparatus invented by Adolph Potdevin for the Potdevin Machine Co., Brooklyn, N. Y. In this mechanism, *Fig.* 3, slack is confined between striker bar 10 (which with plates 8 and 9 comprise the cutting off mechanism) and pinch rolls 4 and 5 so that at no time will there be slack material between striker bar 10 and feed rollers 1 and 2. The idea makes use of an air blast in a unique manner.

The material 3 is advanced by the feed rollers past the cutoff station, over rod or bar 13, to and across plate 16, pinch rolls 4 and 5 and to the advancing rollers 6 and 7. Pinch rolls 4 and 5 travel at a lower peripheral speed than the feed rollers 1 and 2; hence when the active portion 12 of the pinch roll 4 moves to operative position the advance of material 3 is retarded to produce a slack in the material which is desired for the cutting off operation.

At the proper time the two rolls engage or pinch the advancing strip and because of the lower peripheral speed of these rolls a slack will be created in the material. At this point the air blast from nozzle 20 comes into play. Cam 19 is so shaped and timed that as the slack in the material accumulates the plate 16 moves downward, allowing the air blast during this period to drive down the slack portion of the

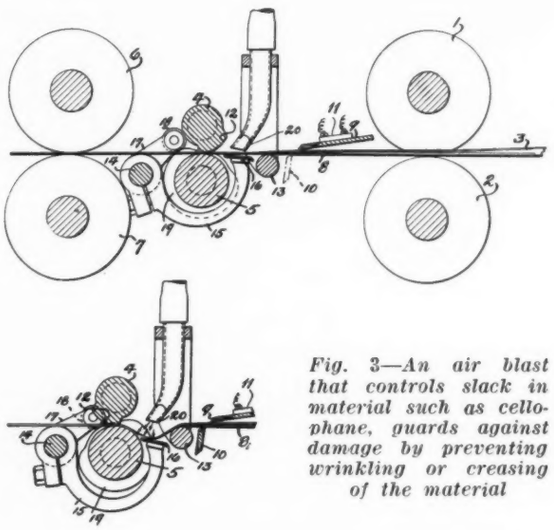


Fig. 3—An air blast that controls slack in material such as cellophane, guards against damage by preventing wrinkling or creasing of the material

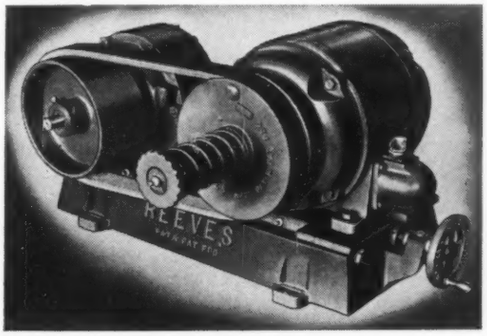
material to maintain tension in the strip from the rod or bar 13 back to the feed rollers 1 and 2, and thus prevent wrinkling and creasing of that portion of the material. It will, of course, be understood that the pinch rolls feed the material, after cutting, to rollers 6 and 7.

Number of this patent is 2,004,129.

NEW MATERIALS AND PARTS

Base Incorporates Reducer

TO MEET increasing requirements for considerable speed reduction through use of a gear reducer in connection with a vari-speed motor pulley, Reeves Pulley Co., Columbus, Ind., has designed a new type of standard mounting which combines these two units on a common base, permitting the vari-speed pulley to drive direct to the reducer. This unit, shown herewith, utilizes the standard stationary base of the motor pulley countershaft unit, but in place of the countershaft is a sliding base, the same as



Gear reducer is combined with vari-speed pulley on a single base

that on which the motor pulley itself is mounted, on which the gear reducer is placed. This base is not movable but is firmly bolted to the stationary base. However, it can be adjusted to various positions as required by the size of the reducer. Any standard make of reducer, within the limitations imposed by the size of the base, can be used. The base is available for all standard sizes of motor pulley.

Control Starts Small Motors

COMBINING modern appearance with a new, simple mechanism, the bulletin 9101 pushbutton motor starter being built by Cutler-Hammer Inc., 328 North Twelfth street, Milwaukee, is adaptable for almost any fractional horsepower application. The switch, shown herewith, provides protection against overloads with a free-tripping thermal overload mechanism. Capacity of the switch can be varied to provide protection for different sizes of motors by changing the heater coil, this coil being readily accessible from the front of the switch by removing the cover plate and two screws. The switch can be used for surface mounting, and as "built-in" control with the self-contained mounting bracket for front mounting or without the bracket for back of cavity mounting. The pushbuttons and their protecting shroud are part of the basic switch mechanism and the complete mechanism is housed in its own insulating shell. Contacts are solid silver to silver "twin-break". Nonrusting mechanisms, stainless steel springs and removable mechanism for wiring are other features.

Pushbutton motor starter combines modern appearance with an improved, simplified mechanism

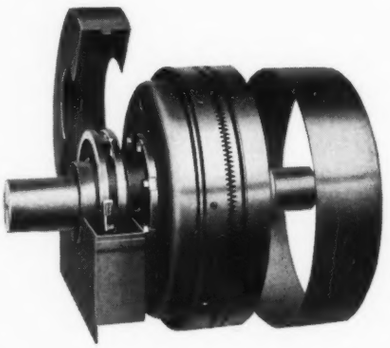
Plastic Has High Impact Strength

PHENOLIC molding material for larger moldings of the deluxe type, known as 2260 K Black Durez, has been developed by General Plastics Inc., North Tonawanda, N. Y. The new material has a higher than average impact strength and is being used on applications where the finest types of moldings are desired. Its impact strength is approximately 33-1/3 per cent greater than the general run of phenolic molding compounds announced previously. It is finding application for instrument cases, adding machine housings, typewriter parts, boxes and containers to withstand rough usage, as well as for many decorative parts and products. It has

a compressive strength of 29,000 pounds per square inch, a heat resistance of 400 degrees Fahr., and weighs 22.2 grams per cubic inch.

Clutch Gives Quick Engagement

POSITIVE, quick engagement and disengagement with less than 1½ degrees of slip is attributed to the newly patented magnetic clutch coupling anounced by Dings Magnetic Separator Co., Milwaukee. The type SCC clutch, shown herewith, transmits high torque, and has been applied on hot and cold strip mills secondary screwdown shafts, soaking pit covers and similar applications where positive engagement and remote control is necessary or desirable.



Internal coil springs disengage clutch which has unusually quick engagement and disengagement

Internal coil springs disengage the clutch. Bronze teeth engage steel teeth in the outer periphery. Lag, due to residual magnetism, is overcome. The cover plate prevents dust and dirt from lodging on the engaging teeth. Engagement is so rapid that "racking" is said to be impossible. A 12-inch diameter clutch of the new type will yield more than 1500 foot pounds torque.

Switches Developed for Heavy Duty

MAGNETIC motor starting switches in two new styles have been introduced by Colt's Patent Fire Arms Mfg. Co., Hartford, Conn. The styles in the new type "MS" switches are local control—up to and including 7½ horsepower; and remote control—in two sizes, one up to and including 7½ horsepower and the other up to and including 25 horsepower. Either style is available for 25, 50 and 60-cycle alternating current motors in the standard voltage ratings. The starters are listed as standard by Underwriter's Laboratories Inc.

Mechanism in the starters is capable of withstanding the constant rough handling usually accorded a switch in a shop or mill. Each pole is broken at two points, minimizing arcing and prolonging the life of the switch. The mech-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FOR MACHINE CONSTRUCTION
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THIS BOOK SHOWS HOW TO DESIGN FOR THE USE OF ROLLED STEEL IN MACHINE CONSTRUCTION
● Insistent demand has led to the preparation of this handy manual for designers, engineers, and production men on the use of rolled steel in machine construction. You'll find here information on the types of application for which rolled steel is best suited . . valuable suggestions on the forms of steel available...short cuts to economy in buying ...hints on how rolled steel and castings may be combined effectively...suggestions on welding technique and stress relief. In short, a booklet which should be in the hands of every manufacturer of machinery—light or heavy. Fully illustrated. The coupon is for your convenience in securing a copy now.
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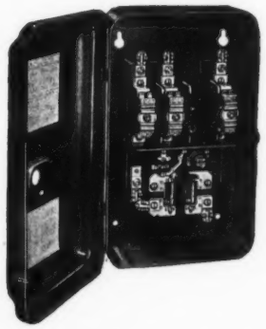
anism is actuated by an electro magnet and the self-adjusting contacts are kept clean by a wiping motion as they seat.

Calibrated thermal relay heaters, conveniently mounted on the front of the switch bloc, control the switching mechanism. When a sustained overload occurs, these heaters react on a bimetallic thermostat which trips the switch, thus protecting the motor from injury. The accompanying illustration shows the switch for remote control.



Mechanism in starters has been designed to withstand the rough handling usually accorded these controls

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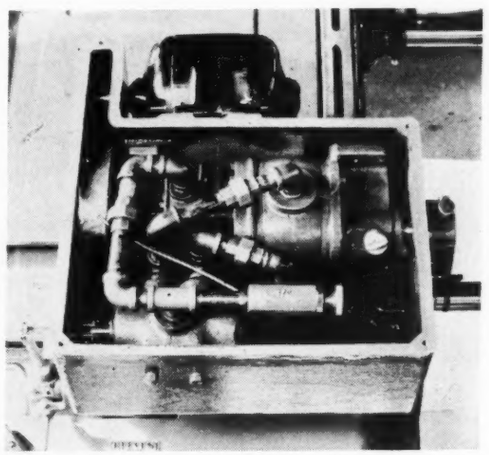
Hydraulic Controls Are Developed

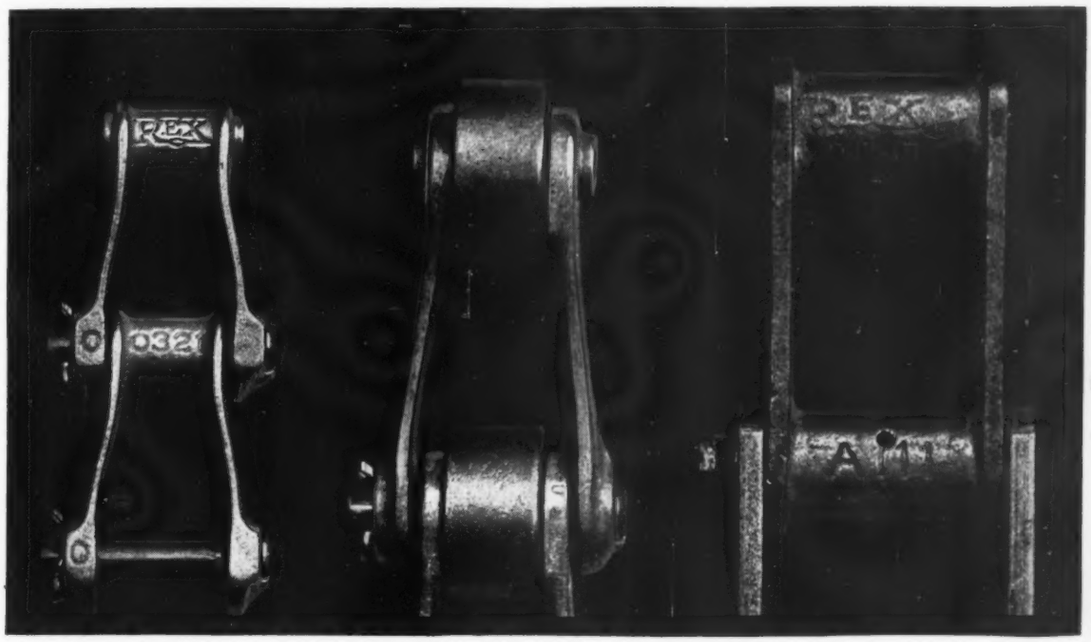
HYDRAULIC automatic control, developed to meet requirements for a speed control which would operate from slight pressure on the indicating lever and would eliminate hunting action, has been added to the control means for infinitely variable speed transmission manufactured by Reeves Pully Co., Columbus, Ind. The new Hydraumatic control is so sensitive that a pressure of only two or three ounces moving the extended lever a small fraction of an inch will bring about a change in speed.



Hydraulic controls automatically vary infinitely variable speed transmission

As with mechanical and electrical automatic

WHERE METAL TAKES *the* WEAR



Rex Griplock *Rex Unicast* *Rex Durobar*

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In any type of severe, corrosive, or abrasive service, Rex Z-Metal adds new advantages to the outstanding advantages of Rex Chains . . .

First Rex Z-Metal adds 40% to the strength of the good malleable iron used in this service with correspondingly longer working life.

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Rex Z-Metal Chain is made in all malleable patterns and produces its greater advantages uniformly in chain of any type.

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CHAIN BELT COMPANY
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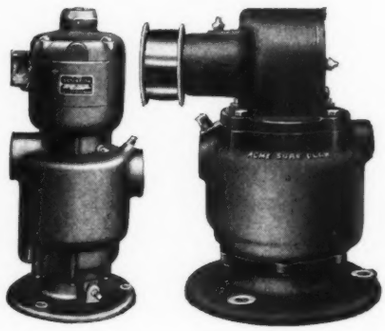
CHAIN BELT COMPANY

REX CHAIN FOR EVERY DRIVE AND CONVEYOR

controls, the hydraulic control is actuated by an indicating lever attached by cable, arm, link or chain to a compensating or floating roll, pressure regulator float, moving part of the machine or any other element from which indication of the required speed can be taken. In the hydraulic control this lever is attached to one of the shifting levers of the transmission through a differential mechanism and vertical and horizontal rods. Thus, movement in lateral direction of the indicating lever is transmitted to the shifting levers which vary the diameter of the disks and V-belt.

Announces New Line of Pumps

PUMPS for handling coolants, water, oil or fluids filled with abrasives which can be applied to any general industrial application which necessitates the transfer of liquids have been brought out by Acme Machine Products Co. Inc., Muncie, Ind. The Sure Flow pumps, shown



New pumps maintain prime without submerging part of the pump in the fluid

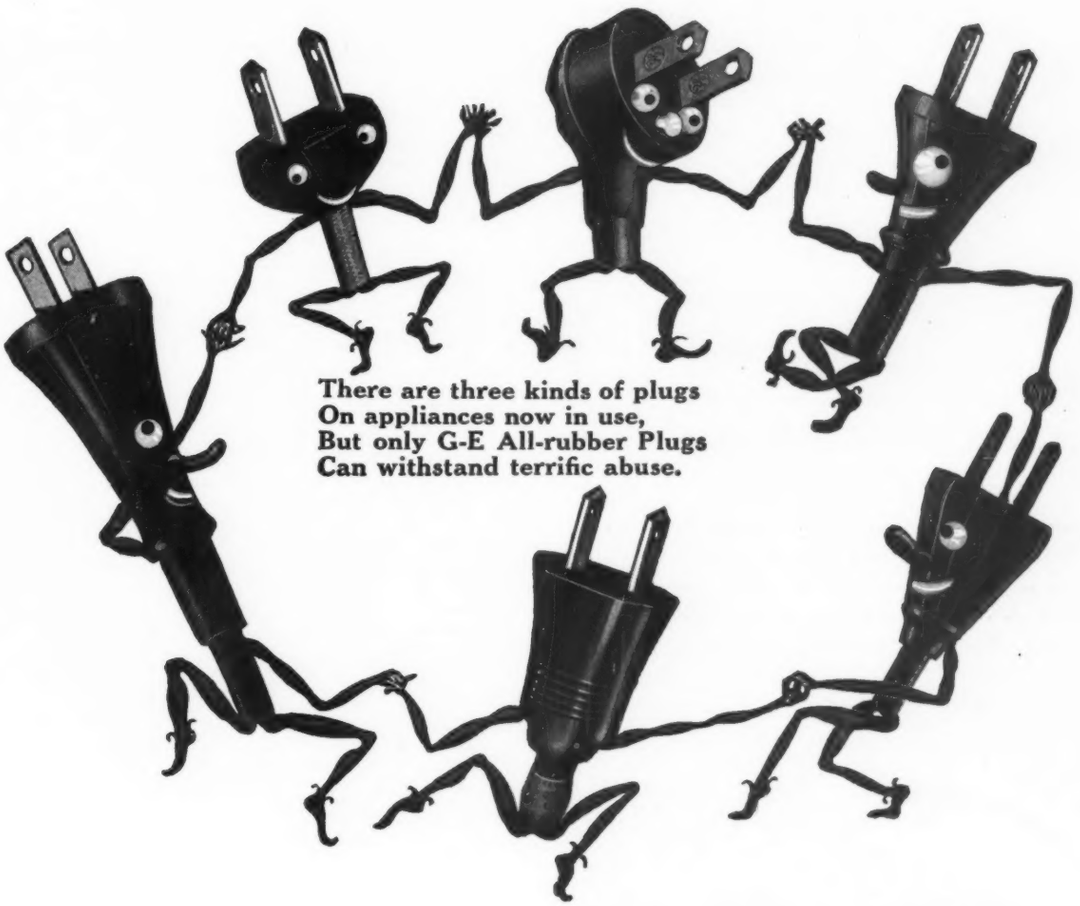
herewith, maintain prime without submerging part of the pump in the fluid to be pumped, and can be installed at any convenient location on a machine and a single line of pipe run to the fluid reservoir.

Belt drive models are available in 4, 10, 20, 50 and 100 gallons per minute capacities. Direct motor drive models are available in 10, 20, 50 and 100 gallons per minute capacities. All models are manufactured for both low pressure and high pressure duty. Either horizontal or vertical base for side wall mounting is optional.

Liquid Rubber Resists Abrasion

TO PROTECT inside and outside surfaces against abrasion, corrosion and acids, Self-Vulcanizing Rubber Co. Inc., Room 516-K, 605 West Washington boulevard, Chicago, has brought out a rubber in liquid form and a rubber in plastic form. The application of this new liquid rubber, called "Self-Vulc" has recently been improved by the development of a new priming compound which makes good results

WHO'S AFRAID OF THE BIG BAD WIFE?**



Inspect G-E All-rubber Plugs closely and at once you see how and why they outlive all other types. General Electric realized the impossibility of training people to treat attachment plugs gently. So G-E designed All-rubber Plugs and Cords of one-piece construction that can be yanked from outlets repeatedly without impairing their efficiency . . . that withstand terrific abuse without breaking or coming apart.

G-E All-rubber Plugs are MOLDED ON-TO THE CORDS IN ONE PIECE . . . not merely attached. They are PART OF THEIR CORDS. Such one-piece construction eliminates cord-set failures. Specify General Electric Cord Sets with All-rubber Plugs for your appliances. Forget that cord sets ever caused you worry. A representative will be glad to call and help solve your cord set problems. Write today to Section Q-328, Merchandise Department, General Electric Company, Bridgeport, Connecticut.

**With apologies to all wives and Walt Disney.

GENERAL ELECTRIC

ACCESSORY EQUIPMENT

MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT

possible by the application of a single priming coat; and both the priming and liquid rubber can be applied like paint—brushed on, sprayed on, dipped on, or poured on. The rubber vulcanizes itself when exposed to the air. "Self-Vulc" plastic is applied with a spatula or other flat tool and like the liquid requires only one prime or preliminary coat and vulcanizes itself cold, when exposed to the air.

In addition to the protection of surfaces, the material can be used to water-proof or corrosion-proof container portions of machines; to absorb shocks on surfaces subjected to impact; and to silence noises.

Bearing Line Is Extended

FELT protected precision ball bearings in the "GreaSeal" line of Norma-Hoffmann Bearings Corp., Stamford, Conn., has been extended to cover three larger sizes—40, 45 and 55 millimeter bore. The line includes three series: "7000" with single felt seal; "7000-P" with single felt seal and plate seal; and "7700" with double felt seal. The two latter series are fully enclosed for retention of lubrication and exclusion of dirt and moisture. All three of these types are self-contained units distinguished by the removable felt seal consisting of closely-fitted felts between removable plates.

Metal Has High Conductivity

HIGH electrical conductivity, great mechanical strength and diversified application are offered by the Mallory 3 Metal recently developed by P. R. Mallory & Co., Indianapolis. The new metal is an alloy consisting predominately of copper and is the equal of copper in coefficient of resistivity, coefficient of expansion, modulus of elasticity and corrosion resistance. The electrical conductivity of the Mallory metal forgings and rods is rated at 80 to 85 per cent that of copper or better. Sand castings of the metal will have an electrical conductivity of 75 to 80 per cent that of forged copper.

Introduces New Temperature Control

FOR use on water cooled internal combustion engines, Edison Electrical Controls divisions of Thomas A. Edison Inc., West Orange, N. J., has brought out a new temperature control. The Edison sealed temperature control forms the nucleus for the device. This control is completely sealed in a glass tube from which all air has been evacuated and replaced by an inert gas. Consequently the contact points cannot oxidize or become pitted by repeated operation. Loss of

calibration due to continuous operation or tampering by an inexperienced person is not possible. The temperature control for engines, catalog M6-D8, consists of this sealed control mounted in a metal tube provided with a standard pipe thread and a suitable junction box for electrical connections.

Liquid Controller Is Redesigned

A NEW type of liquid level control instrument, the Stabilog system of control added to specially designed ball float mechanism, has been brought out by Foxboro Co., Foxboro, Mass. This control instrument, shown herewith, will maintain a level in a chamber within safe limits, and at the same time gives a smooth out-flow without creating upsetting surges.

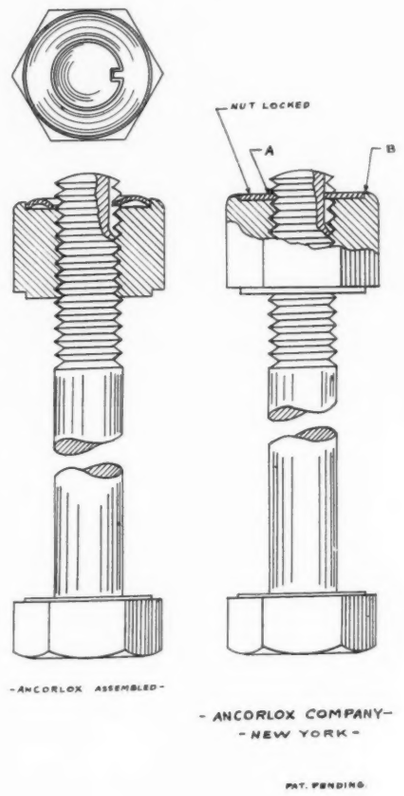
The ball float mechanism is of an entirely new design which employs a knife edge bearing. Also, the steel ball float is counterbalanced by movable weights to insure maximum accuracy. The instrument, shown herewith, is designed so that it can be adapted to any type of installation. It may be installed with the ball float inside the pressure vessel, or on the outside with a kidney type float chamber.

Ball float mechanism in liquid level control instrument employs a knife edge bearing

Expanding Washer Locks Nut

A NEW type of locking device for nuts and bolts is a recent development of Ancorlox Co., 1170 Broadway, New York. In this device, shown herewith, the washers are blanked out of soft steel, brass or other materials with the outside diameter of the blank larger than the counterbore in the nut, and the inside diameter of the blank is smaller than the diameter of the nut. The washer is then formed. This forming operation decreases the outside diameter and

increases the inside diameter, thus allowing the finished washer to be slipped over the bolt and into the counterbore of the nut in locking position. The washer can be locked with an Ancorlox nut or a hollow punch. When the washer is pressed flat, a high pressure is created on the rim of the nut and on the bolt. This pressure, in conjunction with the positive locking tongue of the washer which slides in the grooved bolt, completes the lock.



Forming operation decreases outside diameter and increases inside diameter of the washer so that it may be slipped on the nut. In use, the flattening of the washer creates a pressure on the rim of the nut and on the bolt

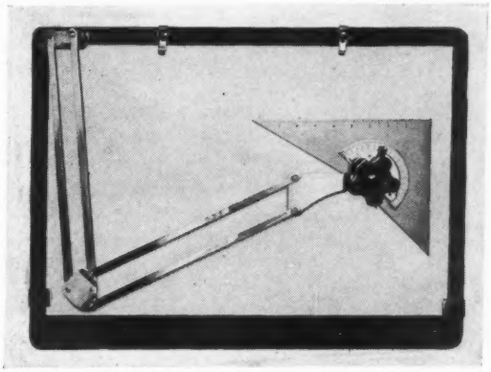
Develops Larger Drafting Machine

DRAFTING machines of a new and larger type, combining light weight, durability, ease of operation and a guarantee of accuracy are being offered by L. G. Wright Inc., 5714 Euclid avenue, Cleveland. The accompanying illustration shows the model A-130 with a board size 18 by 24 inches, on which a drawing as large as 17 by 22 inches can be made. The instrument is a single unit, with paper clips and the mechanism mounted rigidly to a ¼-inch hard black Presdwood board. The parallel mechanism is assembled with solid bronze bearings. A satin nickel finish is employed on the machine.

Angles of 15, 30, 35, 60 and 90 degrees are provided by the special triangle without reference to a protractor. To permit accurate drawing to smaller angles, a 1-degree protractor is mounted on the triangle as optional equip-

ment. The entire unit is so arranged that the protractor may be operated and the machine shifted with one hand.

Instead of thumb tacks, paper clips capable of holding a single sheet or entire pad of paper are used. A variety of interchangeable draw-



Parallel mechanism of drawing machine is assembled with solid bronze bearings

ing attachments, including Vernier protractors and L-Square blades, enable the user to select the one best suited to his work. The same machine is made in smaller models for brief case and desk use.

Floor Model Blueprinter Introduced

A NEW floor model of the Angstrom lamp blueprinter has been introduced by Milligan & Wright Co., 4615 Prospect avenue, Cleveland. This model, shown herewith, has a novel ar-

Drying boards are provided in the base in floor model of alternating current blueprinter

rangement for the washing and fixing trays, and drying boards are provided in the base. Floor space required with trays slid back into the base is 28 by 30 inches. The new blueprinter produces prints with exposures to the incandescent lamp of ¾ to 1½ minutes depending upon the drawing and paper used. A time switch cuts off the current at the end of the exposure selected.

MANUFACTURERS' PUBLICATIONS

ALLOYS (IRON)—International Nickel Co. Inc., New York, has prepared a bulletin giving the properties of nickel alloy cast irons. While the bulletin includes special applications in petroleum production equipment, data is given which will be applicable to all equipment, including a detailed metallurgical discussion of the materials.

ALLOYS (STEEL)—Stainless steels and their application to a wide variety of uses are presented in Vol. 1, No. 1 of *Electromet Review*, now being published by Electro Metallurgical Co., New York. The publication will give news and views of alloy steels and irons.

CONTROLS (ELECTRICAL) — Industrial safety switches, meter service and entrance switches and the company's new line of motor starters are completely presented and described in catalog 58-S being distributed by Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.

CONTROLS (ELECTRICAL) — Cutler-Hammer Inc., Milwaukee, is distributing a bulletin descriptive of its new small drum switch which is applicable to almost any type of single phase, polyphase or direct current motor. Another bulletin of the company gives complete information on the new bulletin 9101 pushbutton motor starter, adaptable to almost any fractional horsepower application.

COUPLINGS—Lovejoy Tool Works, Chicago, has prepared literature on its new type of coupling which has convex jaw surfaces that exert a rolling pressure when bearing on the spider arms.

DRIVES—Hydraulic power is discussed in the 44-page bulletin of American Engineering Co., Philadelphia, which presents pumps designed to furnish high pressure energy that can be translated into variable, reversible linear motion through a ram, or variable reversible rotary motion through a hydraulic motor.

DRIVES—The installation and operation of V-belt drives is discussed in a new simplified 48-page book just published by Gates Rubber Co., Denver. A V-belt drive can be completely designed from the book. Also included are data on V-V drives, quarter-turn drives, double-V drives and V-flat drives.

FLOOR PLATE—A new pattern of 4-way floor plate and two patterns previously available are discussed in a 6-page folder of Inland Steel Co., Chicago.

IRON—Meehanite Metal Corp., Pittsburgh, is distributing bulletin No. 5 which gives an interpretation of the structure of Meehanite, including tables and photomicrographs.

LUBRICATION AND LUBRICATING EQUIPMENT—Fiske Brothers Refining Co., New York, has issued the second edition of *The Lubriplate Film* which includes a complete discussion of frictional resistance.

MACHINE ISOLATION—Deadening or reducing noise produced by mechanical equipment through the use of sound dampening or sound absorbing materials and by isolating vibrating mechanism is the subject of a brochure recently published by Johns-Manville, New York. The booklet specifically covers a number of machines in which sound deadening is especially important.

MOTORS—A complete listing of motors and speed reducers, and engineering information for the selection of motorized speed changers is given in bulletin No. 22-10 of Janette Mfg. Co., Chicago.

PUMPS—Pumps for handling coolants, water, oils or fluids filled with abrasives which can be applied to any general industrial application which necessitates the transfer of liquids are described in a new 24-page catalog of Acme Machine Products Co. Inc., Muncie, Ind.

RUBBER—Self-Vulc plastic and liquid rubber compounds, applied cold and cured cold, which give protection against corrosion, abrasion and chemicals are completely covered in a booklet of Self-Vulcanizing Rubber Co. Inc., Chicago. The booklet gives the characteristics of the material, how it may be applied, and uses to which it has been adapted.

TUBING—Summerill Tubing Co., Bridgeport, Montgomery County, Pa., is distributing an interesting folder which presents some unusual uses of tubing.

WELDED PARTS AND EQUIPMENT—Lincoln Electric Co., Cleveland, has prepared two new application sheets, Nos. 43 and 44 of series 2, covering the redesigning of a cast iron shear for arc welded construction. The sheets describe the process and give the steps followed in working out the all-welded design, together with cross sectional drawings.

WELDED PARTS AND EQUIPMENT—Linde Air Products Co., New York, has published a new booklet entitled "The Metallurgy of Oxy-Acetylene Welding of Steel." In nontechnical language this study covers physical changes such as expansion and contraction, metallurgical effects such as crystallization, heat-treatment and the effect of alloys, and the chemical reactions of steel with its surrounding materials.

WELDED PARTS AND EQUIPMENT—Thermit welding, an alumino-thermic process, is described in a new booklet presented by Metal & Thermit Corp., New York.

WHEELS—Double-wall, manganese steel crane track wheels are presented in a bulletin of American Manganese Steel Co., Chicago Heights, Ill.

Research Publications

Drawings and Drafting Room Practice Standard. Drawing has often been called "the graphic language." So, as a language, it should have a recognized and authoritative dictionary in order that it may be written and read with accuracy and understanding. This standard embodies what seems to be the best present practice. The items covered in this standardization of American practice include the sizes of drawings, arrangement of views, line work, dimensioning and lettering. Published by American Society of Mechanical Engineers, 29 West Thirty-ninth street, New York, 24 pp. 50c.

INDEX TO ADVERTISERS

*Advertisements appear in previous issues.

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MACHINE DESIGN is a monthly technical publication conceived, edited and directed expressly for those executives and engineers responsible for the creation and improvement of machines bui't for sale, and for the selection of the materials and parts to be used.

—Cross Sections—

ARE WE really coming to this? *Ballyhoo* offers, "The modern design of Little Pansy Drill conforms to the effette trend . . . the handles are upholstered in four different shades of satin and instead of the raucous rat-tat-tat of the old style drill the melodious strains of Brahms issue from its svelte form. Little Pansy is the dream drill of the dilettante day laborer."

A GREAT many years passed after Edison made electricity practical before people stopped building houses with both gas and electrical fixtures. We just couldn't bring ourselves to trust this new way of lighting. Now we have completed the transition. Complete electrical control of machinery is here. Complicated motions, genevas, and the rest of the intricate equipment for controlling feeds and movements are being relegated to their proper place.

DETROIT is a great town for new design ideas, but don't make our mistake. Imagine! Trying to talk design when there is an all-star ball game on, and especially one that doesn't include Hank Greenberg.

WITH practically every engineer doing everything in his power to eliminate noise it is interesting to note a machine which is especially designed to create sound. This machine, driven by a small motor, can be adjusted to produce sound waves of various frequencies at the will of the operator. It is used to exercise the ear drums of people who are hard of hearing.

THE REAL test of design is what the user thinks of it, not what the designer believes he will think. And here's one for the builders of transportation equipment. Three men (our curiosity got the better of us after the first one) who have been running all types of city transportation equipment for years didn't mince words in claiming that trackless trolleys were absolutely the best means of city transportation. Those boys who design the other types better get busy!

THE COMBINATION of both heat and motion has often presented some complicated problems to the designer of clothes drying machines. A friend of ours has eliminated the need for intricate mechanisms. He takes hot air, develops a good, powerful stream, then leads it around by means of baffles so that the air does the job of moving and tumbling the clothes in just the manner necessary for perfect drying.

LET'S FORGET what the administration does or what taxes are by reaching into the romance of the efforts of men who dream and plan for the ultimate in design. From such dreams we have attained our present place. Men have already obtained power from the sun, infinitesimal, but still it is power. Radio transmission of power is today the dream of Nikola Tesla and others—and don't underrate Tesla, his dreams have a habit of materializing.

THAT famous poetic crack about engineers having fuzzy ears is taken a little seriously by many people who never have an opportunity of rubbing shoulders with those fine guys that make up the engineering profession. They get the idea that an engineer is either a rough tough hombre who beats the natives every morning for variety, or a meek little fellow who operates an oilcooled slide rule. Of course, we all know a great many engineers who have innumerable interests outside the profession. We'd be interested in what you do when you're not on the job—the little things that make this old world more exciting. Is it golf, acting, amateur photography? If it weren't for starting an argument we'd offer a prize for the best ideas for employing spare time. Drop us a card with your idea and maybe we will get around to the prize after all.

Business and Sales Briefs

GENERAL ELECTRIC CO. has moved all divisions of its Air Conditioning department, including design, engineering and manufacturing activities, to 5 Lawrence avenue, Bloomfield, N. J.

* * *

Rollway Bearing Co., Syracuse, N. Y., has appointed Fred W. Kulicke as Philadelphia representative, taking the place of John W. Firmin who died recently.

* * *

J. K. Baylis has been appointed manager of sales in the Buffalo district for Bethlehem Steel Co.

* * *

Republic Steel Corp. has removed its district sales offices at Buffalo to 1020 Liberty Bank building. Thos. B. Davies continues in charge of the offices as district sales manager, assisted by his previous staff.

* * *

Mark Spraley, for several years assistant sales manager of Joyce-Cridland Co., Dayton, O., has assumed the duties of sales manager of the pump division of Acme Machine Products Co., Muncie, Ind.

* * *

James T. Sutliff, who for many years was located at the factory of Roots-Connersville Blower Corp., Connersville, Ind., is now associated with the Chicago office of the company at 20 North Wacker drive.

* * *

A Detroit sales office has been established by Hydraulic Press Mfg. Co., Mt. Gilead, O., at 2842 West Grand boulevard, Detroit. This office, which will serve the state of Michigan together with Northwestern Ohio and Northeastern Indiana, will be in charge of Reider Thoreson.

* * *

Paul B. Allen has been appointed vice president in charge of sales for Otis Steel Co., Cleveland, succeeding J. G. Carruthers, resigned. Howard E. Robinson, formerly general manager of sales of Newton Steel Co., Monroe, Mich., has been named general manager of sales for Otis at Cleveland, succeeding Mr. Allen.

* * *

United States Rubber Products Inc., New York has announced the following changes in personnel. W. S. Long, formerly manager of mechanical sales in the Seattle district has been transferred to the Los Angeles district as manager of mechanical sales at that point. C. W. Gilmer, formerly salesman in the San Francisco district has been appointed manager mechanical sales in the Seattle district. Arch Miller has been appointed as packing representative for the Pittsburgh district. The New Orleans branch of the company is now located at 440 Canal street.

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Motors, like men, are versatile only to a certain point. From there on, each one must have special characteristics to be of the most value on the job.

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Fairbanks-Morse builds a *complete* line of motors—a line that enables you to get exactly what you want without compromise. Our men never have to sell motors that "might" do for the service you require.

Each one is built electrically and mechanically to handle heavy service—each is equipped with the finest ball bearings that can be found. Bearing mountings are built to take punishment and to give real service. This superb construction is the result of engineering that runs far back into the history of industrial power—and it means more in service, more in dependability.

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